

A photograph of two hornbills on a tree trunk. One hornbill is perched on a branch in the upper left, facing right. The other is on a lower branch, facing left, with its wings spread, showing black, white, and yellow feathers. The background is a dark, out-of-focus forest.

A PHOTOGRAPHIC GUIDE

HORNBILLS OF THE WORLD

PILAI POONSWAD

ALAN KEMP

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HORNBILLS are easy birds to recognise, with their long down-curved bill and the casque on top. Most species depend on mature tropical rainforest and vast expanses of wilderness for feeding and nesting sites. They are mainly omnivorous, i.e. they eat a combination of animal and vegetable foods; but each species has specific food preferences, foraging techniques and, within the forests and savannas, preferred foraging heights. As a result many different species can co-exist in the right habitat.

Hornbills are among the most charismatic and biologically interesting birds in the habitats where they occur. The most distinguishing aspect of their behaviour is that of the female sealing herself into a nest cavity for all or most of the breeding cycle. She leaves only a narrow slit through which the male passes her food and, as she will usually moult all her flight and tail feathers and becomes flightless while incarcerated, she depends completely on the male to feed her and her young.

Currently (2013), 25 out of 57 species of hornbills are either globally threatened or near threatened with global extinction, mainly due to human activities such as habitat clearance and hunting. Even then, there is still time to conserve and enjoy the majority of species in their natural environments. Where threats to their existence have become severe, there are approaches and techniques that can delay and hopefully reverse their slide towards extinction, provided that there is awareness of their presence and problems, and compassion for their special place on Earth. Out of this compassion we must develop a local, national and international will to conserve them.

This book is the first monograph to come out for almost 20 years about hornbills. It is the first one ever to collect and present all the best photographic images that are available about this fascinating order of birds. It is important that we understand the status, requirements and ecology of hornbills; in this way we will be better able to stop their decline and help them recover. Please enjoy this book, and give an extra copy to someone you know with an interest in birds, or to someone who can help protect the hornbills and their magnificent habitats.

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HORNBILLS OF THE WORLD

A P H O T O G R A P H I C G U I D E

PILAI POONSWAD ALAN KEMP MORTEN STRANGE

Photography by **Tim Laman and others**



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Front cover: Great Hornbill *Buceros bicornis*, pair at nest in Thailand.
Photo: Baramée Temboonkiat

Back cover: Top: Silvery-cheeked Hornbill *Bycanistes brevis* male from
Ethiopia. Photo: Marie-France Granouillet
Middle: Malabar Pied Hornbill *Anthracoceros coronatus* female with fruit from
Karnataka state, India. Photo: Niranjana Sant
Bottom: White-throated Brown Hornbill *Ptilolaemus austeni*, male at nest in
Thailand. Photo: Narong Suwannarong

Front flap: Red-billed Hornbill *Tockus erythrorhynchus* northern nominate
race, male at nest from Ethiopia. Photo: Piotr Jonczyk

ABOUT THE COVER

The photograph on the front cover of this book shows adult male and female Great Hornbills *Buceros bicornis* photographed by Baramée Temboonkiat from GreenAsia Production team. The female is sitting at the nesting hole, and the male shares his fruits with her. This particular nest was first discovered inside the Khao Yai National Park in 1982. Khao Yai is a 2,168 km² forest wilderness two hours drive north-east of Bangkok in Thailand, now a World Heritage site, an area where the Thailand Hornbill Project did some of their first research work on hornbills and where the work continues to this day.

The nesting tree is a huge *Hopea odorata*, a hardwood tree (DBH 99 cm, height 45 m). The cavity (28 m above the ground) has been used year after year by not only the Great Hornbill, but also successfully in some years by the sympatric Wreathed Hornbill. One nesting season, a pair of Oriental Pied Hornbills even occupied the nest, but without success. The Thailand Hornbill Project has built an observation hide on the ground near this nest and monitors breeding activities every year. Photography from the tree has been featured in Kemp (1995), Tsuji (1996), Kemp (2001) and now on the cover of this book. This particular photograph captures the faithful nature of hornbill couples, and the critical role that suitable nesting holes in large growing forest trees play in hornbill breeding ecology. Over the 30 years since this nest was first discovered, a Great Hornbill pair has produced 16 chicks, and the nest cavity was repaired twice (1999 and 2008). In 2012, the pair nested again, but this time lost their chick to a Yellow-throated Marten.



Khao Yai National Park, Thailand. Morten Strange



A male Wreathed Hornbill. Thailand Hornbill Project



A male Great Hornbill. Thailand Hornbill Project

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PREFACE

The foundation of modern hornbill research was built on a comprehensive museum-based monograph on the order by Kurt Zanft, published in 1960. In 1995, *The Hornbills* by Alan Kemp came out, extending Zanft's work and including details on hornbill biology. Since then, there has not been any attempt made to treat this charismatic group of birds in a monograph. Volume 6 of *Handbook of the Birds of the World* came out in 2001 and includes an excellent coverage of hornbills, also by Alan Kemp. However, Kemp (1995) is long out of print and Kemp (2001) is not a monograph exclusively about hornbills, as it includes many other different bird families and orders.

During the past 20 years, much new information about hornbills has come to light, through excellent field research in both Asia and Africa. Just as significantly, with the development of modern digital photography, a wealth of new photographic material has been produced. Ten years ago, some hornbills had never been photographed in the wild; today we can collect and present quality in-habitat photographs of all species, as well as all significant subspecies and plumages. So with all three writers involved in this project into their 60s, we felt that now was the time to pool our resources and present what we know about hornbills, their evolution, features, status and conservation.

This book is the result. It does not replace previous works by authors such as Kemp (1995), Kemp (2001) or Kinnaird & O'Brien (2007), nor is it nearly as comprehensive and detailed with regards to specific aspects of hornbill ecology as Poonswad & Kemp (1993), Poonswad (1998), Lum & Poonswad (2005), Kemp & Kemp (2007) or Davidson (2011). Obviously, these references will retain their importance and significance.

Instead, we see this new book rather as a supplement to existing sources of hornbill information, as a summary of what we know today, and as an attractive presentation of the diversity and the ecology of wild hornbills. With the use of photography, we can now show the bird where it belongs: in its natural habitat, flying, feeding, and nesting freely and without manipulation. At its best, a bird photograph is both a piece of natural history documentation and a small work of art, i.e. the photographer's interpretation of the bird in its favourite environment at a certain place and time.

The support we got from outside contributors and travelling nature photographers was overwhelming and heart-warming. In spite of our (very) limited budget to pay for pictures, no less than 62 photographers made their best work available to us. It is not really fair to single out anyone, for each photograph is important and represents a major effort, but we would like especially to thank Tim Laman of *National Geographic* fame. Tim is an old friend of Pilai's and made his stunning world-class material available to us without hesitation. Check out Tim's astonishing website at timlaman.com for more of his work.

The book was initially made possible during a very pleasant lunch meeting with a longtime supporter of nature in Asia, who prefers to remain anonymous. We thank him and his family for their unwavering support. Four major Thai companies later provided additional funding for the project, thereby ensuring that all proceeds from the book will be directed to the Hornbill Research Foundation to provide support for hornbill research and conservation.





Pilai and Alan have a long history of co-operation dating back decades; here they admire a male Wreathed Hornbill during one of Alan's visits to Thailand. Thailand Hornbill Project



Morten started working with Pilai during the 1990s; this snap-shot was taken inside a hide in southern Thailand in May 1998 while waiting for a Helmeted Hornbill to visit its nest nearby. Morten Strange

thanks the Thailand Hornbill Research team for their hard work and profound efforts on field data collection and analysis. She also wishes to thank all colleagues and collaborators from the Faculty of Forestry, Kasetsart University, the Wildlife Conservation Society, the Faculties of Veterinary Science at Mahidol and Chulalongkorn Universities, the Department of Design and Products, Silpakorn University and the friends and students who support this research in cash and in kind. She deeply thanks all sponsors that have funded hornbill research, particularly the Hornbill Research Foundation, ICC International Public Company Limited, National Center for Genetic Engineering and Biotechnology (BIOTEC), as well as PTT Exploration and Production Public Company Limited (PTTEP).

Facing page: Without doubt, this is one of the best hornbill photographs ever produced, used in Kemp (2001), on the cover of Kinnaird & O'Brien (2007) as well as in *National Geographic Magazine*. We are proud to bring it here as well: Tim Laman's study of a male Wrinkled Hornbill feeding in the canopy of the Sundaic rainforest.

Morten Strange would like to thank his two co-authors and friends for making this book possible, as well as all the talented and hard-working photographers that he corresponded with throughout the project. But especially, he would like to thank his partner and project director Ng Bee Choo, since without her nothing he does would make any sense.

Alan Kemp would like to thank Meg, who has been at his side for over 40 years, for her wisdom and support, and Lucy and Justin, our offspring, for trying to keep us sane and normal. Many people and organisations have assisted us in our search for hornbills – we remember them all fondly and thank them for making everything we have done so exciting and productive.

And finally in Thailand, **Pilai Poonswad** would like to first apologise for not being able to list the names of all the people to whom she owes so much during her thirty plus years of hornbill research. She is grateful to the National Park, Wildlife and Plant Conservation Department (formerly the Royal Forest Department) and the Department of Microbiology, Faculty of Science, Mahidol University for having continuously granted permission, collaboration and support of hornbill research.

She is deeply indebted to late Dr. H. E. McClure, late Professor Dr. Rachit Buri and Mrs. Katharine B. Buri, late Mr. Phairot Suvanakorn, Emeritus Professor Dr. Pornchai Matangkasombut, Dr. Pradon Chatikavanij, Dr. Niphan Rattanaworaphan, Mr. Vijit Yarnpirat, Mr. Ugrit Borvonvinyanant, Mr. Boonchai Benjarongkakul and Niwat Kongpien. for their unreserved encouragement and support. She

EVOLUTION, DISTRIBUTION AND RELATIONSHIPS

Hornbills are easily recognised birds by their long down-curved bill and the casque on top. The characteristic casque is well developed and elaborated in many species in different sizes and shapes. In South America one might mistake a large-billed toucan (a kind of barbet) for a small hornbill; but hornbills do not occur in that so-called 'New World', they are found only in Africa and Asia, having a so-called 'Old World' distribution. The finer details of hornbill anatomy are also definitive, such as their unique, fused atlas and axis neck vertebrae, 2-lobed kidney and long flattened eyelashes. The most distinguishing aspect of their habit, in all species apart from the two ground-hornbills, is that of the female sealing herself into a nest cavity for all or most of the breeding cycle. The closest relatives of hornbills are hoopoes and woodhoopoes, another Old World group, while more distant relatives include rollers, bee-eaters, kingfishers, motmots and todies, maybe woodpeckers, barbets and honeyguides, and possibly even trogons or the Cuckoo-roller. Within this assemblage, most hornbills stand out for the large body size that many species attain.

Evolution

When, where and how hornbills came into being is far from clear. A first estimate of **when**, based on a molecular study of the cytochrome b gene from the mitochondria within their cells, indicates that hornbills and hoopoes split from a common ancestor about 75 million years ago (Ma), just before the extinction of the dinosaurs that marked the end of the Cretaceous geological era. The ancestors of modern (so-called 'crown group') hornbills only arose about 52 Ma and later (from the Early Eocene era), represented now by the two African genera of *Tockus* small-hornbills and *Bucorvus* ground-hornbills. Not long after that,

at about 47 Ma (Middle Eocene era), a major diversification occurred, a so-called 'explosive radiation', that gave rise to the ancestors of all the remaining types of hornbills (13 genera in all), some in Africa, such as *Tropicranus*, but most of them in Asia, especially *Berenicornis*, with both these genera appearing among the earliest ancestors.

Where hornbills came from is even more open to conjecture. The best clues normally come from the fossilised remains of ancestors, but for hornbills and hoopoes these are few. A tiny ancestral hoopoe-like fossil is known from deposits in France from about 47 Ma, and fossils of several more distantly related orders are also known from what is now Europe and North America. The only known hornbill fossils are from much more recent times, about 5–15 Ma (Miocene era), two extinct species of ground-hornbills from Morocco and Bulgaria, so they do not shed much light on where hornbills originated. At the time hornbills are thought to have arisen, 75 Ma, the layout of the world's landmasses was very different from today, but how the continents looked then and came to be in their modern positions is well documented from studies of continental drift and plate tectonics. Prior to the early hoopoe-like fossil, North America, Europe and Asia were united as a single northern continent named Pangaea, while the only other continent at the time, to the south, Gondwanaland, was busy splitting up into South America, Africa, Madagascar, India, Australia and Antarctica. Without any fossil evidence, the modern distribution of hornbills is unreliable as an indicator of where the group might have originated, since we have no way of knowing from what areas they might have disappeared, and so, at present, the most parsimonious theory on their origin is from Pangaea (Europe), where fossils of their earliest relatives are known, and from where they might have spread to their

modern range of Sub-Saharan Africa (the Afrotropic Ecozone or zoogeographical realm), continental and oceanic Asia (the Oriental Ecozone), with a single species reaching the northern Australasia Ecozone.

How hornbills actually came into being is at this stage just an educated guess. It is likely that the first hornbills were small and insectivorous (insect-eating), like the hoopoes and woodhoopoes that are their sister-order, and like most of their other more distant relatives. The only modern hornbills that still fit this bill are the two species of dove-sized dwarf-hornbills that inhabit the rainforests of Africa, smallest among the 14 species of the African genus of *Tockus* small-hornbills and co-habiting with the African woodhoopoes. It is suspected that hornbill ancestors were forest dwelling species, hopping about in the branches, only coming down infrequently to hop on the ground, and scratching themselves over the wing (indirectly). Hoopoes (but not woodhoopoes), five other *Tockus* species, and even the two African species of *Bucorvus* ground-hornbills spend much of their time walking on the ground, all are insectivorous and carnivorous (flesh-eating), and all scratch without dropping the wing first (directly), but it is suspected that these are more recent developments when the climate became drier and savanna or grassland vegetation replaced much of the forest. Of the other 41 species and 13 genera of hornbills that arose during the 'explosive radiation' from about 47 Ma, all are forest-dwelling and arboreal. Only nine species and three genera from this radiation are represented today in Africa, with all the rest (32 species and 10 genera) spread through continental and south-eastern Asia, and Australasia. One African insectivorous species, alone in the genus *Tropicranus*, resembles but is much larger than one of the dwarf-hornbills, and it may be the sole representative of a

Toucans

Toucans are sometimes confused with hornbills but are in fact not related. Toucans and aracaris are a family of birds in the Piciformes order that also includes woodpeckers and barbets among others; three different species out of 40 species in the toucan family Ramphastidae are featured here. However, in a case of convergent evolution, the two groups share some traits such as the large bill, the ability to reach far out to pick fruit, aided by support from the stout strong legs and broad grasping feet, and the wide gape. Compared with the Neotropical toucans, however, hornbills have only a short tongue, and so they pick up food in the bill tip and then toss it backwards into the throat to swallow, always with great control and agility. Morten Strange



Many-banded Aracari *Pteroglossus pluricinctus*.



Crimson-rumped Toucanet *Aulacorhynchus haematopygus*.



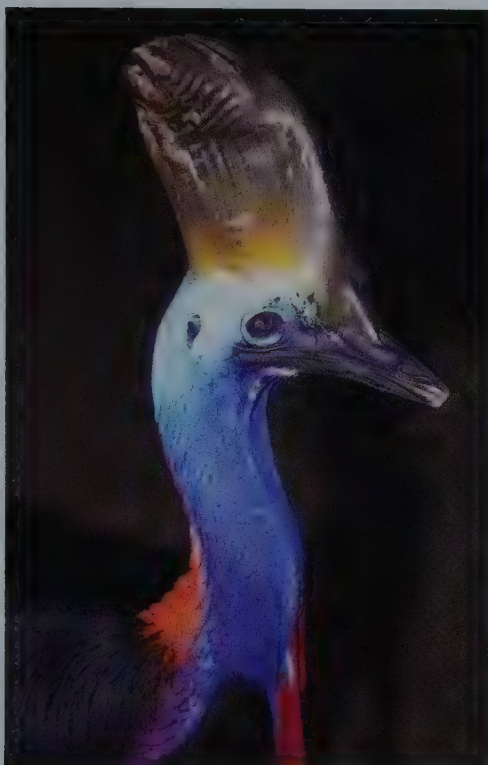
Ivory-billed Aracari *Pteoglossus azara*.

large form of that early prototype. However, all the Asian and the remaining two African genera represent a new foraging development, being primarily frugivorous (fruit-eating), and therein lies a remarkable coincidence and tale.

Distribution

At the time of the 'explosive radiation', about 47 Ma, continental Asia was still part of northern Pangaea, with the moist tropical vegetation typical of that prolonged wet and warm climate over continents (megathermal/warm mega-continent) during which the forests were dominated by palm trees (Arecaceae) and other ancient flowering plant families with large-fruit, including Annonaceae, Burseraceae, Lauraceae, Meliaceae and Myristicaceae, except for fig trees (Moraceae). Suddenly, there appeared a whole new suite of plant types, including many now typical of modern Asian forests, such as the tall hardwood Dipterocarpaceae trees and those ancient families of large-fruited trees. This botanical 'invasion' occurred in two waves: the first into Sundaland, the core of modern Asian forests across Malaysia and western Indonesia, at around 48 Ma, and the second into mainland Myanmar/Burma around 39 Ma. During the first wave, the Indian sub-continent was passing at its closest to Sundaland, en route from Africa to its massive collision with the Asian mainland, where the second wave occurred just before the Himalayas were pushed up and the climate of the Asian continent changed from ever-wet to seasonally monsoon. It is possible, that fruit-eating hornbills, known now to be capable of transporting and dispersing the large-seeded fruits of the tree families in this 'new' forest, met India, adopted a frugivorous diet, and played a major role in the vegetative invasion. The search is now on for further supporting evidence.

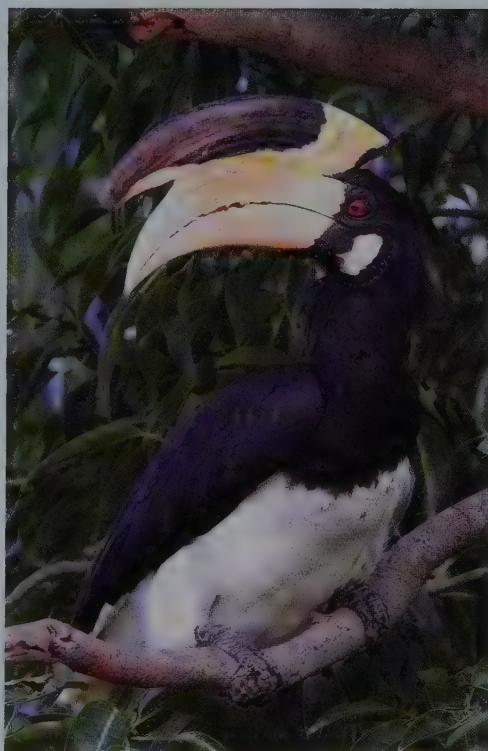
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Extensions of the upper bill covering are not unique to hornbills, although they are most widespread and elaborated within that family. Helmeted Guineafowl of Africa has a casque-like bill structure which is more of a skull prominence. However, cassowaries such as this Southern Cassowary *Casuaris casuaris* from New Guinea have casques, and like hornbills, theirs is also spongy bone within and the bill sheath on top. Morten Strange

Right: All hornbills have casques, but their sizes differ widely from the barely noticeable casque of the female Hemprich's Hornbill (top) to the huge structure of a male Malabar Pied Hornbill (right). The purpose of the hornbill's casque is not fully understood, but it is believed to provide primarily structural support for the long bill, and it could also act as a resonating chamber to amplify the hornbill's call. Since the casque is always bigger for the male and only develops with maturity, a large casque could also serve as a social signal of increased status and virility.

Piotr Jonczyk, Christoph Moning



The study of hornbill relationships is a work in progress. The White-crowned Hornbill *Tropicranus albocristatus* (previously Long-tailed Hornbill) of Africa (below) was previously placed in genus *Tockus*; and it has also been placed previously in the genus *Berenicornis* together with White-crowned Hornbill *B. comatus* of South-east Asia (bottom). However, it is now agreed to be sufficiently distinct in aspects of morphology, voice and ecology to merit treatment in its own genus. Pete Morris, Thailand Hornbill Project





It is possible that hornbills spread from Africa to what is now India and South-east Asia, adopted a frugivorous diet, and played a major role in the spread of fruiting trees. Today hornbills have evolved to occupy a wide range of habitats from the savanna of Africa (Southern Ground-hornbills, top) to the dense ever-green forests of equatorial South-east Asia and New Guinea (Rhinoceros Hornbill, above). Tim Laman

Relationships

The end result of all this diversification of hornbills is the range of surviving (extant) species that are with us today. These species represent the 'leaves' at the tips of the 'twigs' of the hornbill family 'tree'. Like any family tree, below these leaves lies the history of that tree, embodied in the complex branching sequences of twigs, forks and branchlets that link the leaves to the original hornbill bough from where it split off from the hoopoe bough. If we knew all the details of what had happened back in time, from when the hornbill tree started out as the first hornbill on its single twig – all the leaves shed or knocked off (extinctions) and all the twigs and branches dead or broken (fossil lineages) – we could deduce how the tree came to be of its present size and shape. Of course, there has been only one history, and therefore only one form of the tree, so all our efforts to resolve it will converge on a single answer, if we are ever clever enough to discover it.

Our classification of hornbills attempts to summarise this complex branching pattern within their 'bough' of the avian tree, each 'fork' defined by novel changes in one or more of the characters used to re-construct the evolutionary history of the tree.

For example, on the hornbill 'bough' itself, the first 'fork' is where the two species of African ground-hornbills of the Family Bucerotidae diverged from the remaining 55 species of nest-sealing hornbills in the Bucerotidae. Soon after that, the second 'fork' is where the nest-sealing hornbills split off an African 'branchlet' of 14 small-hornbill species in the genus *Tockus*. Within that generic 'branchlet', the 'twigs' divide until they end in 14 terminal 'leaves', each representing a species with its own binomial scientific name in Latin, such as *Tockus flavirostris* for the Eastern Yellow-billed Hornbill.

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The same applies to all the subsequent branching and leafing events on the tree, the first iteration of which is indicated in the accompanying figure (see opposite page). Such a tree and classification provides more information than just the pattern of branches and twigs, or the formal names of species. On such a tree, one can overlay any type of

information relevant to hornbills, such as where they occur, the geology, climate and habitat they occupy, how they behave, what they eat, how they breed, what parasites they carry and which calls they utter, and each approach will generate its own pattern across the tree, giving insights into how the ecology, behaviour and relationships came into being. Then, once we

know the relationships between all the species and all these layers, information from well-studied species can be applied to little-known species, and from common species to rare or threatened species in need of conservation attention.

Our current preferred classification looks like this:

Class Aves Superorder Bucerotes

Order Bucerotiformes (hornbills)

Family Bucervidae (ground-hornbills)

- Genus *Bucorvus* (ground-hornbills)
2 spp, African, carnivorous, savanna, terrestrial

Family Bucerotidae (nest-sealing-hornbills)

- Genus *Tockus* (small-hornbills)
14 spp, African, insectivorous, savanna/forest, arboreal/terrestrial
- Genus *Berenicornis* (white-crowned hornbill)
1 sp, Asian, frugivorous, forest, arboreal
- Genus *Tropicranus* (white-crested hornbill)
1 sp, African, insectivorous, forest, arboreal
- Genus *Rhinoplax* (helmeted hornbill)
1 sp, Asian, frugivorous, forest, arboreal
- Genus *Anthracoceros* (Asian pied hornbills)
5 spp, Asian, frugivorous, forest, arboreal
- Genus *Ocyrceros* (Indian grey hornbills)
3 spp, Asian, frugivorous, savanna-forest, arboreal
- Genus *Anorhynchus* (bushy-crested hornbill)
1 sp, Asian, frugivorous, forest, arboreal
- Genus *Ptilolaemus* (brown hornbills)
2 spp, Asian, frugivorous, forest, arboreal
- Genus *Buceros* (great hornbills)
3 spp, Asian, frugivorous, forest, arboreal
- Genus *Bycanistes* (white-rumped hornbills)
6 spp, African, frugivorous, forest, arboreal
- Genus *Ceratogymna* (wattled hornbills)
2 spp, African, frugivorous, forest, arboreal
- Genus *Aceros* (rufous-necked hornbill)
1 sp, Asian, frugivorous, forest, arboreal
- Genus *Rhyticeros* (wreathed/wrinkled hornbills)
9 spp, Asian, frugivorous, forest, arboreal
- Genus *Penelopides* (tarictic hornbills)
6 spp, Asian, frugivorous, forest, arboreal

Order Upupiformes (hoopoes/woodhoopoes)

Family Upupidae (ground-hoopoes)

- Genus *Upupa* (ground-hoopoes)
1-4 spp, African and Eurasian, insectivorous, savanna, terrestrial

Family Phoeniculidae (woodhoopoes)

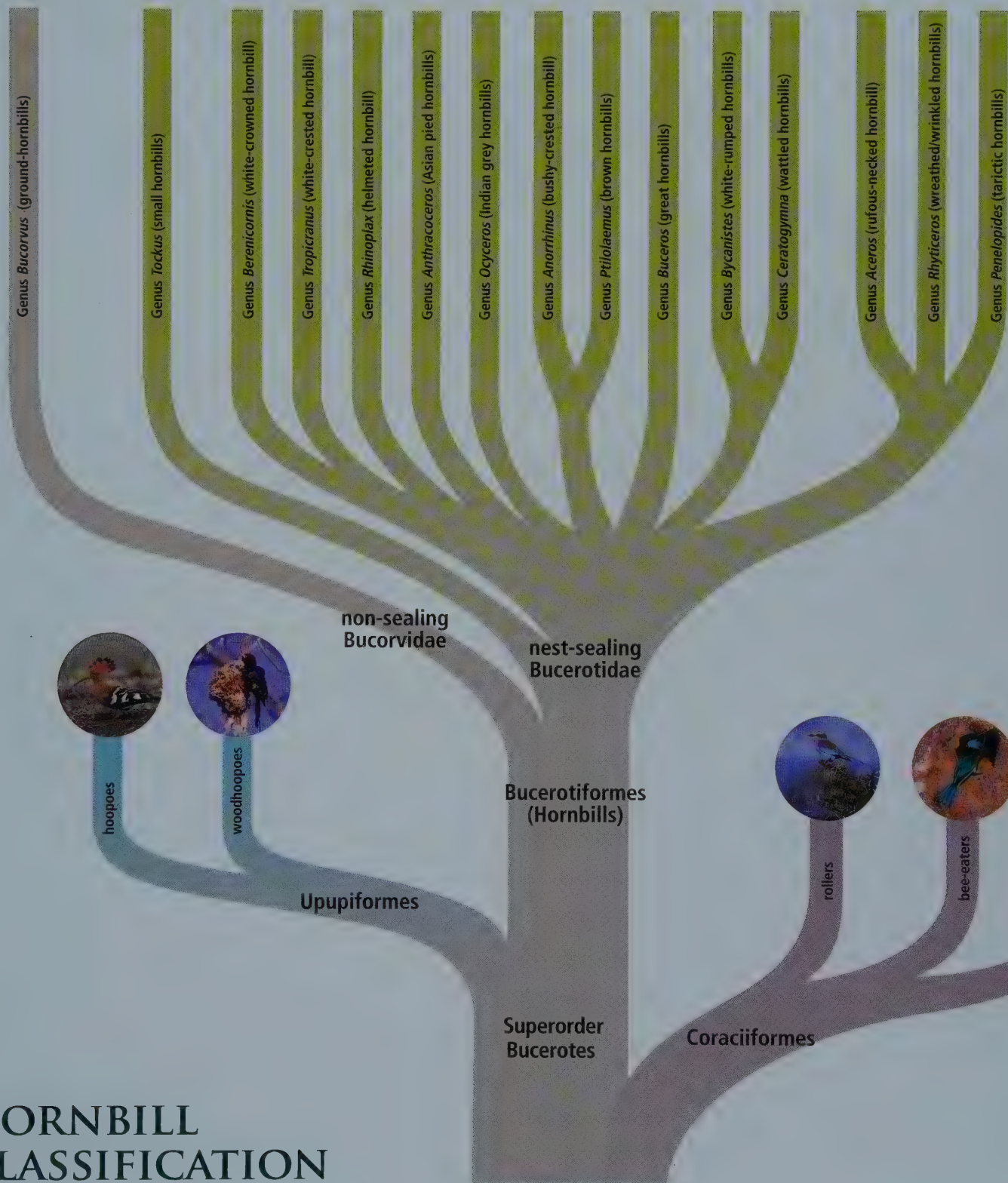
- Genus *Phoeniculus* (woodhoopoes)
5 spp, African, insectivorous, savanna-forest, arboreal
- Genus *Rhinopomastus* (scimitarbill)
3 spp, African, insectivorous, savanna-forest, arboreal

Opposite page:

African Hoopoe, South Africa. Con Foley
Green Woodhoopoe, Kenya. Morten Strange
Lilac-breasted Roller, Kenya. Morten Strange
Blue-throated Bee-eater. Ong Kiem Sian
Oriental Dwarf Kingfisher, Malaysia. Morten Strange

Note: A collective name at an even higher level, Picocoraciidae, has been proposed recently for hornbills and their more distant relatives in the orders Coraciiformes (rollers and ground-rollers), Alcediniformes (kingfishers, bee-eaters, motmots, todies) and Piciformes (woodpeckers, barbets, honeyguides); with Trogoniformes (trogons) and Leptosomidae (Cuckoo Roller) less well assured of membership of this grouping, as part of an expansive 'landbird' assemblage.

HORNBILL CLASSIFICATION



GENERAL HABITS

Hornbills are diurnal birds, and most begin their day at first light, although some, including ground and helmeted hornbills, call and even move around on moonlit nights. Often, they emerge from the roost at dawn to perch in the open for a while, preening or calling, before they move off to forage. Those that feed on evenly dispersed food sources, such as insects, can begin to feed from the moment they leave the roost and continue feeding as they move about during the day. Other species that feed at patchy food sources, such as fruiting trees, may have to fly long distances before they reach food, and then spend periods during the day moving between different feeding sites. In the breeding season, radio tracking of breeding males of Great and White-throated Brown Hornbills found that these roost near a fruiting tree, particularly a fruiting fig tree. Their first feeding visit to the nearby tree begins before dawn.

Staying in shape

During the day, as they go about their business, hornbills maintain themselves by a number of basic behaviour patterns. The majority of their time spent on maintenance activities is devoted to preening the feathers. Because of the long bill, this behaviour frequently results in adoption of awkward postures to reach various parts of the body, the neck often arched during preening of the breast, one wing at a time held wide open as the bird reaches for its primaries, or the tail twisted and expanded to one side or the other. Allopreening is also a fundamental form of behaviour between pair-members, and especially between all members of co-operative groups. It augments the care given by an individual in tending its plumage, even though its primary function is probably that of social facilitation. In addition, food is often passed back and forth between individual



This pair of Oriental Pied Hornbills from Singapore (male on the left) has just emerged from a roost and a bath in the rain-soaked leaves of a tree, and they dry out in the early morning sun. Morten Strange

hornbills during such social encounters. Rather than being concerned with any nutritional requirement, this passing of food is probably more a test or expression of dominance, and such interactions over food are particularly common among members of co-operative groups.

During preening, application to the plumage of preen oil from the preen gland at the upper base of the tail is an activity that hornbills carry out frequently. This is achieved either by nibbling at the gland to transfer oils to the tip of the bill, or by leaning backwards and rubbing the sides of the head and bill across the gland. Special attention is also paid to

cleaning the bill and the casque, which involves rubbing them across a perch or nearby branch, or biting repeatedly on a thin twig or piece of bark to reach the inside surfaces.

Bathing in wet foliage is sometimes performed after rain, either in wet grass on the ground or among the dripping branches above. After the plumage is wetted, all bucerotid species dry out the plumage, holding the wings drooped and the tail fanned.

Hornbills often sunbathe, usually with the back facing the sun, the head feathers raised, the preen gland exposed, and the wings drooped at the sides to expose the back. Some species, however, adopt more elaborate postures.

The *Buceros* hornbills, for example, perch with the wings open and the head lolling to one side, while others, such as the *Bucorvus* ground-hornbills or the African Grey Hornbill, even lie flat out on the ground with both wings and the tail spread. In addition, to keep the feathers healthy Asian hornbills are known to do dust-bathing to get rid of ectoparasites, many kinds of feather mites and Mallophaga. Oriental Pied Hornbills are often observed to perform this dusting behaviour.

Those hornbills that live at higher altitudes or latitudes with colder temperatures

sometimes need to gain heat at the start of the day. Some of the smaller *Tockus* species show a type of “warming-up” behaviour, in which they droop the wing on one side only, exposing the back to the morning sun. On the other hand, several species living in hotter climates have special postures that enable them to lose, rather than gain, heat; either they spread the “wrists” to expose the bare skin under the wings, or they gape with the bill open to release heat from the lungs and the moist inner surface of the mouth. In the ground-hornbills, the upperwing-coverts are also raised to lose



The feathers are very important to hornbills, and the majority of their time spent on maintenance activities is devoted to preening them. Here a female Von der Decken's Hornbill from Kenya keeps its plumage in top shape; the preen gland is above the base of the tail and not visible from this angle. Morten Strange



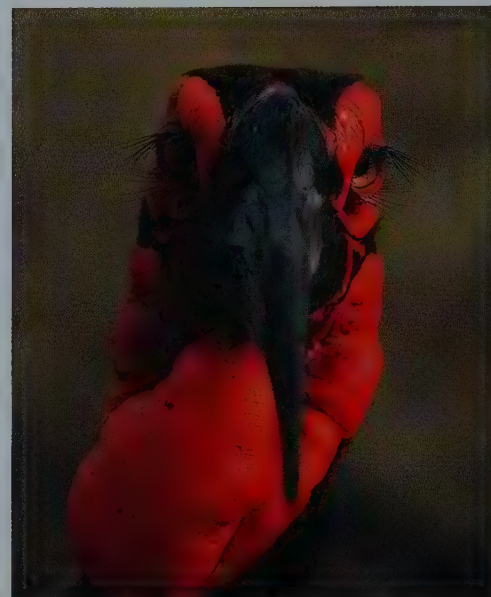
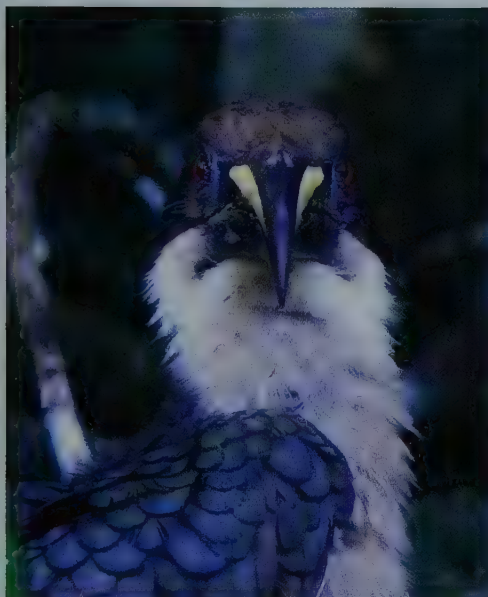
During social encounters, food is often passed back and forth between individual hornbills. Here a male Sri Lankan Grey Hornbill entices the female with a fruit. Amila Salgado

heat, producing a ‘chrysanthemum’ effect. It is suspected that, in these and some other species, heat is also radiated via the extensive bare facial skin; some species even inflate this bare skin, thereby increasing its surface area.

Basic actions

There are a few basic actions that are common to most of the Bucerotiformes. When nervous, hornbills often make short, jerky movements of the head and neck, sometimes with the body held low and the head peering out from below the level of the perch. Restless behaviour such as hopping along or around branches is observed when the hornbills are disturbed. More aggressive behaviour involves lifting the bill to expose the colours of the throat and bare skin, and this often leads to redirected aggression, shown by pecking hard at the perch; at times it can result in more serious conflict, including bill-wrestling or even real fighting. Special threat postures are adopted by only a few hornbill species, such as the White-crowned Hornbill, which spreads its wings and

GENERAL HABITS



Hornbills have excellent vision and can in fact see the tip of their bill, something few other birds can. This gives them exceptional control of the bill and a strong binary vision demonstrated here by a Sri Lankan Grey Hornbill female from Sinharaja Forest Reserve (left) as well as a Malabar Pied Hornbill male from Udawalawe NP, also in Sri Lanka (centre). This structure of the head also allows hornbills to scan the sky above them freely; and as an extra feature, small feathers above the eyes, clearly visible here on a male Southern Ground-hornbill from South Africa (right), act as eyelashes. The lashes may serve as shields to protect and shade the eye, and they may also provide a social purpose for the hornbills by enhancing the appearance of the eyes, including the small coloured patch of skin around them that many hornbills have. Christoph Moning (2), Tim Laman

tail, or the Helmeted Hornbill, which crouches with the tail raised and the bill at the ready. For intense aggressive behaviour prior to aerial jousting, the Helmeted Hornbill will butt its casque strongly and loudly against the perch and emit aggressive calls.

Most Asian forest hornbills are vocal during the early morning, when the birds wake up and communicate while preparing to fly out from the roost to feed, in family groups or in flocks. Vocal response to disturbance is also common for forest hornbills, especially the large hornbills such as the Helmeted, Great and Rhinoceros Hornbills.

Certain types of behaviour also occur that have no obvious or immediate function. These include mandibulating sticks in the bill, tossing over of debris, fast aerial chases, and contact actions such as bill-wrestling and jumping on or over each other. Such behaviour

is seen most often from juveniles, especially in co-operative groups such as those of Southern Ground-hornbills and in Great Hornbills when flocking, and it is sometimes termed 'play'. Adult birds do sometimes perform these kinds of behaviour, but, as if disturbed by all the activity, they also interfere with and break up groups of playing juveniles.

Only a few species of hornbill have a ritualised form of territorial display, and these are mainly the ones that feed more on animal foods and are territorial throughout the year. This applies to most of the small *Tockus* species of Africa, some of which perform displays with the head bowed accompanied by clucking calls and others executing this behaviour with the head raised and whistling calls, the display being elaborated further in some cases by the opening of the wings and the spreading of the tail. At least two, quite unrelated species

end their display by fanning the tail above the back: Hemprich's Hornbill in Africa and the Rufous-necked Hornbill on the Asian mainland. Closely related species often perform very similar display movements and calls, as exemplified by the quartet of Eastern and Southern Yellow-billed Hornbills and Von der Decken's and Jackson's Hornbills.

At the end of the day

Individuals of most species of forest hornbills roost on an outer branch of a tree, often at a preferred perch that is used night after night. The larger species frequently perch more in the open, or just in the lee of the canopy to protect them from the weather. Great and Wreathed Hornbills tend to choose a roosting tree with rather slim branches that provide springy roosting perches such as on bamboo. Such perches probably offer the best warning

from climbing predators, which are presumably unable to reach the roosting bird without being noticed. Interestingly, smaller hornbills often choose branches that are below the canopy, where they are shielded from aerial predators. Some of the small *Tockus* species on the African savanna roost close to the main branch, probably because this camouflages them from the variety of predators searching among these more open trees and bushes.

Most hornbills return nightly to the same roost-site, or have a selection of regular sites within their territory or home range amongst which they alternate at irregular intervals. Only a few species, such as ground-hornbills that traverse very extensive territories, do not have a regular roosting site; instead, they fly up into a tree or on to

a cliff face at whatever place they happen to end the day. Nomads in search of fruit may also roost wherever they come to rest, but often, at least in the non-breeding seasons, they may gather in huge flocks at favoured regular sites, using these information centres

to guide them when they spread out again the next day over long distances in search of fruiting trees. Wreathed and Plain-pouched hornbills may then gather and disperse in their thousands, providing one of the greatest birding spectacles in the world. ■



Hornbills often sunbathe; here a large flock of Silvery-cheeked Hornbills from Ethiopia has gathered out in the open in the mid-day sun. Raphael Jordan



Groups of hornbills often roost together at a preferred perch night after night; here six Bushy-crested Hornbills from Borneo cosy up together. Bjorn Olesen



Only a few species of hornbill engage in a ritualised form of territorial display, but most of the *Tockus* savanna species of Africa do, such as this pair of Eastern Yellow-billed Hornbill from Ethiopia (it is the male on the left). Raphael Jordan

FEEDING ECOLOGY

Most hornbills are omnivorous, in that they eat a combination of plant and animal foods, although there is a tendency for each species to eat mainly fruit or mainly small animals. Each species of hornbill has specific food preferences, foraging techniques and, within the forests and savannas, preferred foraging heights. As a result, up to eight species may co-exist within an area, each one having its own particular feeding niche. Most of the predominantly frugivorous species live in forest, while the majority of species with carnivorous tendencies live in savanna habitats.

Fruits or meat

The proportions of different types of food in the diet vary during the year, depending mainly on availability and phases in the annual cycle. There is, however, a tendency for frugivorous species to include more animal protein in their diet when nesting. Highly frugivorous hornbills, such as the Wreathed Hornbill, which consume very little protein from animal food (5–8% of total diet), consume high protein fruits such as *Polyalthia* spp (Annonaceae), *Cinnamomum subavenum* (Lauraceae), *Aphanamixis polystecha*, *Dysoxylum densiflorum* (Meliaceae) and *Ficus altissima*, *F. toxicaria* (Moraceae) which contain 6–12% protein by weight. *Cinnamomum subavenum* appears to be an important nutritious fruit of four hornbill species during the egg incubation phase at Khao Yai NP, although this tree produces fruit only every other year and for relatively short periods. Its fruit contains 5.7% protein, 31.9% fat and 37.4% carbohydrate, and yields 6.4 Kcal/g. Most hornbills do not drink water and, even though it has been reported for a few species, drinking does not appear to be regular or essential. Water must therefore be obtained from the food, so some may be selected more

for its liquid than for its nutritional content. For example, out of 50 fruit food species analysed for nutritional values, some *Ficus* spp (Moraceae) and *Elaeagnus latifolius* (Elaeagnaceae) yielded the lowest calories (0.6–1.5 Kcal/g), but they contained very high moisture content (86–87%).

Hornbills occupy a variety of ecosystems, situated within several different floral and faunal assemblages. This brings each species into contact with a different set of plants and animals, among which it must survive and find food. Ripe fruits of three main categories are eaten. These are figs or syconia, which mostly are rich in carbohydrates, water and especially calcium, drupes or capsules, which are rich in lipids, often housed in thick husks, and other juicy fruits; but all are fruit types that are easily detached from their seed. Figs often form the dietary staple, especially when adults are forming eggs, producing new feathers or raising growing chicks; this being due to the high calcium levels of some fig species. In Thailand, predominant families of hornbill fruit diet plants during the breeding season include Annonaceae, Lauraceae, Meliaceae, Moraceae and Myristicaceae; all of which are rich in protein (on average 5.6–8.1%), fat (avg. 6–22%) and carbohydrate (avg. 42.7–59.6%). Other fruits are taken as available, or when needed to provide fats for chick-raising or to supply liquids to counter possible dehydration. In Kalimantan (Indonesian Borneo), hornbills were found to consume fruits from 128 tree species, and were suspected of exploiting a further 144 species, but altogether there were over 900 species of fruit present in the study area. A single hornbill species may eat up to 96 species of fruits and, across the order's entire range, 748 plant species in 252 genera and from 79 families have been reported in hornbill diets. Out of 660 plant species of

389 genera in 112 families recorded at Khao Yai NP, Thailand, 139 identified species (or 21%) of 76 genera (19%) in 36 families (32%) are eaten by the four hornbill species occurring there. Their gentle treatment of seeds within the fruits as they digest away the fruit pulp, their mobility and their relatively long retention times for seeds make hornbills important seed-dispersal agents within forests. This works to mutual benefit for themselves as well as for their food plants, particularly for those important food species that have very large-stoned seeds, such as *Canarium euphyllum* (Burseraceae) (seed size: 25 x 40 mm, weight: 12 g) and *Aglaiia spectabilis* (Myristicaceae) (26 x 50 mm, 12 g).

A variety of prey

The various items of animal prey taken by hornbills cover most major vertebrate and invertebrate orders. At least 100 taxa may be taken by small *Tockus* hornbills living on the African savanna. The largest hornbills, ground-hornbills, may eat less taxa but their diet extends from hares, gamebirds, and tortoises down to termites and grasshoppers.

Most Asian species were once thought to be exclusively or largely frugivorous. More recent research, in particular involving nest watches of certain species, has revealed a surprising variety of food sources targeted by breeding hornbills. The diet of nesting Rufous-necked Hornbills studied at Huai Kha Khaeng WS in western Thailand, for example, consisted of 13 identified types of fruit and at least 20 types of animal including beetles, butterflies, caterpillars, cicadas, click beetles, orthopterans, centipedes, crabs, millipedes, scorpions, both non-flying and flying lizards, geckos, skinks, earthworms, fish, frogs, birds and their eggs. Nest watches of four hornbill species at Khao Yai NP, also in Thailand, have recorded no less than 70 varieties of animals,



including mammals, such as bats, squirrels and rodents; reptiles, including the Green Pit-viper, geckos, skinks and flying lizards; birds, including barbets, nightjars, bulbuls, pigeons, Collared Scops-owl, kingfishers and Greater Racquet-tailed Drongo, and eggs of some of those birds. Invertebrate animals included a great proportion of arthropods, including insects of more than 30 species such as cicadas, beetles, leaf insects, ants, wasps and bees (including hive material), grasshoppers, stick

insects and moths. The hornbills also provided centipedes, millipedes, scorpions, snails, snail shells, crabs, worms, frogs and fish to the nestlings.

So, the hornbills of the South-east Asian forests prove to be formidable predators of animal prey. The astonishing spectrum of food stuffs which they deliver at the nest is obviously collected not only in the canopy, but also from the understorey and the forest floor, and seemingly from around streams



Most hornbills feed on a combination of fruits and meat, such as the Sri Lankan Grey Hornbill; here two males with animal prey (left) and fruits (above) respectively.
Pathmanath Samaraweera, Gehan de Silva Wijeyeratne

and pools as well. It confirms that hornbills increase consumption of animal foods during the nesting season, particularly after the chicks have hatched, presumably in order to meet the protein and calcium requirements of egg production and nestling growth. At other times of year, they revert to a more frugivorous diet.

Hunting parties

Several hornbill species associate with other animals while hunting. Those African *Tockus* species that live in forest habitats will follow army ants, parties of other bird species, bands of squirrels or troops of monkeys for the insects they disturb. On the African savanna, Eastern Yellow-billed and Von der Decken's Hornbills follow bands of Common Dwarf Mongooses and capture the locusts disturbed by those mammals. This behaviour has even developed into a mutual relationship, in which the hornbills take over sentry duties to warn

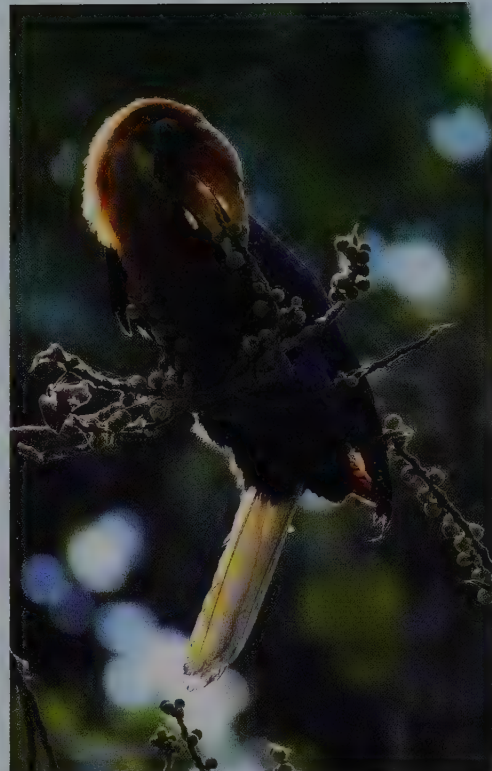
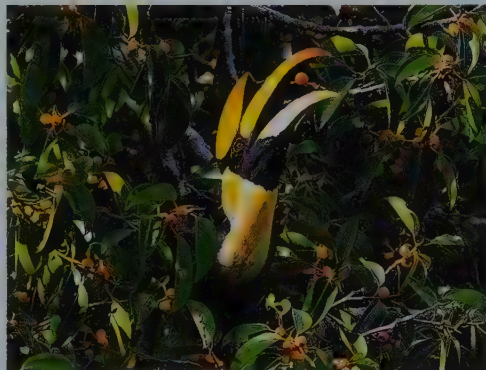
FEEDING ECOLOGY

mongooses of the proximity of predators. Other carnivorous birds will also sometimes accompany hornbills, examples being the *Melierax* chanting-goshawks that follow ground-hornbills in Africa and the *Spizaetus* hawk-eagles that associate with Asian forest hornbills.

Animal foods are usually distributed relatively evenly across the habitat, but are difficult to find. Most carnivorous species are therefore sedentary, territorial and rather thinly spread across their chosen habitats. Territory size varies from as much as 200 km² for the ground-hornbills down to 1–2 km² for the huge Asian hornbills, and to as little as 10 ha for the small African terrestrial *Tockus* hornbills. This allows individuals or groups of each species to defend an area in which they can hunt undisturbed, spend relatively long periods searching for food, and learn the daily and seasonal details of where and when to find prey.

Searching for fruits

Fruiting trees, on the other hand, tend to have a patchy distribution and to be clumped in both space and time. In order to cope with this unpredictability, the frugivorous hornbills develop special types of behaviour to enable them to locate and track their food sources. Most species are not territorial, since they have to range widely in search of fruiting trees, and they are not evenly distributed, since they tend to congregate in flocks and around fruiting trees. Some large Asian forest hornbills, such as Great and Wreathed Hornbills, are estimated to range over 600 km² and may travel for 50 km from their tagging site. Whereas the largest African frugivorous species have been tracked to at least 100 km from where they were originally captured. The majority of frugivorous hornbills also have good communication abilities, allowing individuals



Almost all hornbills take some fruits, and for the large genera like *Bycanistes*, *Buceros* and *Rhyticeros* fruits form the main part of their diet outside of the breeding season. Here (clockwise from top left) a Black-and-white-casqued Hornbill from Uganda, a Narcondam Hornbill from India and a Great Hornbill from Thailand, all males.

Tadusz Rosinski, Kalyan Varma, Narong Suwannarong

to keep in contact while they search for food. Most gather at communal roosts, which may serve as centres of information, and have loud flight calls and wing-beats to enable them to maintain contact. How they actually locate ripe fruits within the forest is not totally apparent; but their responses to other hornbills and fruit-eating animals, and their avian use of avian UV sensitivity may play a role in some instances.

Several different species may congregate at sources of food, or assemble to share communal roost-sties. Flocks of conspecific Asian hornbills may also congregate to roost together at some specific sites used repeatedly, often far away from their feeding ground. Such

sites can be characterised by being on a slope or in a valley (for Wreathed, Rufous-necked, Great, Rhinoceros, Bushy-crested and White-throated Brown Hornbills) or along the forest edge (for Oriental Pied Hornbill). Seeds of a wide variety of fruits are dropped under the roosting trees.

Medium-sized to large hornbills can consume 100–300 ml of fruit in one session, an amount which can be made up by anything from four large figs to 200 small ones. Seeds from these and other fruits are regurgitated within an average time of 67 minutes, the period ranging from 19 to 110 minutes, or they are expelled by defecation after a slightly longer



Hornbills increase consumption of animal foods during the nesting season, particularly after the chicks have hatched; this female Great Hornbill has left the chick inside the nest and now brings it a snake. Thailand Hornbill Project



Hornbills use their long bills skilfully to pry prey out from leaves and branches; here a female African Grey Hornbill from Kenya locates and lifts out a larvae from the bark. Morten Strange

FEEDING ECOLOGY



The *Tockus* hornbills of Africa are territorial and active hunters that will pursue prey vigorously within their home range; the savanna species often drop down to the ground and spend most of their time hunting there, such as this male Northern Red-billed Hornbill of the nominate race from Ethiopia looking for prey in a pile of game dung. Adriaan Dijkse



This series of portraits of a male Crowned Hornbill shows the variety of prey items that a *Tockus* hornbill will bring to the nest. Hugh Chittenden

average time of 83 minutes. The seeds do not suffer any damage during their passage through the digestive tract, large ones being regurgitated after digestion of the fruit pulp and small ones passing through the gut for defecation. Thus, as the hornbills are roaming in search of fruit resources and travelling between fruiting trees and roosting sites, they are well suited to disperse the seeds of forest plant.

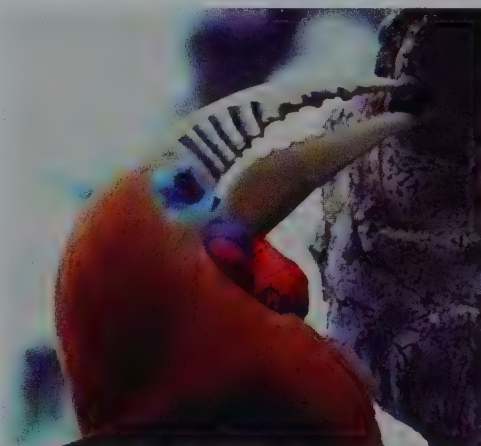
The bill and food

Hornbills use the bill to collect food, employing a variety of techniques. The simplest method is just to pick food where it is found, but a hornbill will also uncover concealed food by levering over or lifting objects, or by digging into the ground, under bark or into soft wood. Not surprisingly, uncovering food is most prevalent among but not confined to the terrestrial species. Hornbills will snatch hanging fruit or active animal prey from vegetation or the ground while in flight, and they will even hawk aerial prey on the wing. Most items are simply swallowed whole. Large items, however, may be broken up, separated into edible and inedible parts, as by removing fruit husks or insect wings, and then crushed or softened in the bill. Certain distasteful foods, such as sticky fruits or hairy caterpillars, or slimy items, such as molluscs, may be wiped on a branch or the ground before being swallowed.

On the bucerotid bill, the tips of the mandibles always meet precisely, as with a good-quality pair of forceps. They can be used delicately, so as to procure bird's eggs without breaking the shell, or with force, in order to crush a skull or break open a fruit capsule. Only in a few small *Tockus* species, however, do the inner surfaces of the mandibles meet, forming sharp cutting edges. In most other hornbill species, they are separated by a gap, with the inner margins becoming jagged in



The hornbills are important seed dispersers, the seeds eaten by the bird are regurgitated, or they are expelled by defecation, and end up on the forest floor where they can germinate, as this carpet of seeds below the nest of a Wreathed Hornbill illustrates. Thailand Hornbill Project



Do hornbills have teeth? In some hornbills, such as on *Aceros* and some *Rhyticeros* and *Penelopides* species, the mandibles develop and wear with age to form teeth-like notches that serve to crush/squeeze/break food items. If you look closely at the Rufous-necked Hornbill on page 167 you can clearly see the 'teeth'. Morten Strange

some species, to enhance their holding and crushing capability.

In some hornbills such as most *Tockus* and *Buceros*, the bill seems to grow out directly forward (except for a slight downcurve to follow the mandible bones); then its growth lines are essentially parallel to the inner tomial surfaces, and so no notches develop. However, in others, the growth lines are more down-curved than the mandible bones, so that they arrive at intervals along the tomia and, being of variable thickness on and between lines, wear to form the teeth-like notches that one sees, certainly on ground-hornbills as well as on *Aceros* and some *Rhyticeros* and *Penelopides* species. So, while the tips are for snatching/tossing/gripping items, the gaps serve to crush/squeeze/break items, like a nut-cracker, and so the effect of notches/teeth/wear developing with age are greater between the tip and base of the bill. ■

BREEDING ECOLOGY

The nesting habits of hornbills have long attracted attention; for in all members of Bucerotidae the female seals herself into a nest cavity and leaves only a narrow slit through which the male passes food to her and later her chick. Also interestingly, the female hornbill while incarcerated usually becomes flightless, through a simultaneous moult of her main flight and tail feathers as she commences egg-laying. Additionally, she and the chicks keep the nest clean by squirting their droppings out through the opening in the sealed nest entrance. Only the two *Bucorvus* ground-hornbill species, placed in their own family Bucorvidae, do not seal their nest cavity, but the female is still fed at the nest although she emerges at least daily to defaecate.

The basis for the curious nesting behaviour of hornbills probably lies in its anti-predator advantage. It has been shown that hole-nesting birds suffer lower predation rates than do those that build open nests, and the predation pressure is presumably reduced further by minimising the size of the entrance slit. Most hornbill nest cavities in trees have a tall chimney above the floor, which provides a further retreat should any predator breach the sealed entrance.

Pair formation often seems to occur some time before maturity, possibly initiated in the roaming flocks of immature and non-breeding birds that are reported for most species, while in more sedentary species the pair-members usually remain together

throughout the year. In co-operative species, the dominant, or alpha, breeding pair of a group is assisted by other members, usually sub-adult males, in such matters as nest territorial defense and supply of lining material for the nest, while any immature birds present in the group provide additional help with the delivery of food to the nest inmates. Co-operative breeding is known to occur in eight species, and is suspected in a further ten, but while up to a third of hornbill species might adopt a co-operative mating system, its origins or functions have not been exhaustively studied.

The nest

Hornbills are unable to excavate a nest, so all species nest in natural cavities, usually in



The nesting tree can vary in size considerably, from the huge hardwood tree preferred by this Wrinkled Hornbill to the small tree being inspected here by this female Sri Lankan Grey Hornbill. Thailand Hornbill Project, Chandrasri Narampanawa



trees, but sometimes also in rock faces where these are available. The only variation on these preferences is that a few species such as Plain-pouched, Oriental Pied, Brown Hornbills and several *Tockus* species use the old nest-hole excavated by a large barbet or woodpecker, while the ground-hornbills will, on rare occasions, nest in the disused open stick nest of another bird species or even excavate their own cavity in an earthen bank. Meanwhile, hornbills in many places are facing nest shortages. The important clues for this are nest abandonment and nest competition. An increasing number of hornbill species will adapt to use more unusual cavity-like objects which are available or an artificial cavity if that is provided, such sites ranging from the bee-hive logs adopted by

ground-hornbills in Nigeria to the modified tree cavities and artificial nests supplied in the rainforest of Thailand or suburbs of Singapore. In the arid semi-desert of Namibia, where there are few trees, the members of a large study population of Monteiro's, Red-billed, Southern Yellow-billed and African Grey Hornbills now breed in man-made nestboxes. The final selection of the cavity appears to be made mainly by the female.

Many nest-sites are used in successive seasons, and often the same pair of adults is involved. In addition, competition for nest-sites often exists and can be as high as 40% of total nesting attempts, both within and between species, so that a favourite nest cavity may be used by two or three species in succession or,



There is competition in the forest for good tree holes suitable for nesting; here (left) a monitor lizard *Varanus* sp is leaving a former Oriental Pied Hornbill nest after a female attacked it, and a family of Indian Giant Flying Squirrel *Petauristas philippensis* occupies another potential nesting cavity (above).

Pilai Poonswad and Atsuo Tsuji

among smaller species, one tree may contain enough cavities to accommodate two different species simultaneously. In Thailand, Plain-pouched Hornbill nested in a higher hole of a woodpecker, while Oriental Pied Hornbill nested in the lower one at Huai Kha Khaeng Wildlife Sanctuary; also, Rhinoceros and White-crowned Hornbills nested in the same tree at Budo Sungai Padi National Park.

The pair often visits several holes before choosing the final site. The pair also becomes especially territorial prior to nesting, and this applies even to frugivorous species that are not normally territorial, but which, at this stage in the cycle, defend at least the area around the nest. In new research, Great Hornbill breeding pairs at Khao Yai National Park showed nest site defence all year round by responding strongly to the playback of calls at the nest site. Territory sizes may range from 10 ha for small savanna species or nest-site areas of larger ones to >100 km² for ground hornbills, while some frugivorous species may have to range over hundreds of square kilometres in search of fruits during the non-breeding season.

BREEDING ECOLOGY

In several species, the colours of the facial skin become especially bright before breeding, and those species that apply yellow green oil on their feathers become busier to beautify themselves. Any displays that occur are performed more intensely and repeatedly, and often the male remains in close attendance near the female to guard his paternity. Before nesting, the male will frequently offer the female food in courtship feeding, but sometimes he will also offer food at the cavity entrance, which suggests a strong additional attraction to the nest itself. The female, prior to sealing in, may spend long periods sitting quietly in the nest, pecking at the walls, cleaning the nest by throwing out old nest debris, rearranging lining or accepting food. Such pre-nesting behaviour may go on for a few weeks. It is performed at variable intensity, and does not always culminate in sealing-in and egg-laying.



There is also inter-specific competition for good nests. Here a female Wreathed Hornbill has entered a nest also claimed by a male Great Hornbill.

Narong Suwannarong

Nesting season

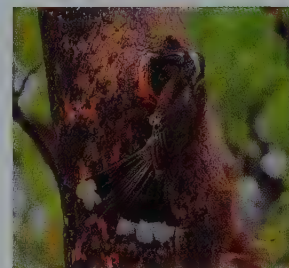
Most hornbill species are seasonal breeders, especially in those habitats where there is a marked wet or monsoon season separated by a drier period. Species of the African savanna and woodland all start to breed at or just before onset of the rains, when many savanna trees come into leaf in anticipation of the rains, while ground-feeding species start later once the terrestrial vegetation emerges. Mud for sealing also becomes available with the rains, but more importantly, arthropod and other animal food increases in abundance and accessibility with the availability of new foliage and higher temperatures and humidity. Most Asian hornbill species start their breeding at the onset of the cool-dry season when the forest trees flower and ripe fruits are plentiful in time for chick rearing.

Many frugivorous hornbills lay only when fruit is sufficiently abundant, either to support the female for egg-laying or to



In Huai Kha Khaeng Wildlife Sanctuary, Thailand, it was found that 90% of Plain-pouched Hornbill nests were originally made by a woodpecker, mainly the large Great Slaty Woodpecker *Mulleripicus pulverulentus*.

Narong Suwannarong



Notice the elaborate sealing performed on the nest by an African Grey Hornbill in Nigeria (above). In the photo to the left a male visits the nest. John Sawyer

nourish the chicks after their emergence from the nest. In Thailand, each species has a nesting cycle of different duration, but all start in the height of the dry season, with hatching or fledging nevertheless synchronised to coincide with the onset of the drenching monsoon rains. In less seasonal tropical rainforests, such as those of Equatorial Central Africa and the Sunda subregion in South-east Asia, nesting may occur at irregular intervals, and often not annually, since bouts of fruiting might be triggered at any time by a period of low, rather than high rainfall.

Entering the nest

When conditions develop that are suitable for breeding, copulation occurs at intervals during the day, either around the nest, during visits for its preparation, or away from the nest. Various types of pre-copulatory behaviour have



While most hornbills can land vertically at the nest and support themselves with the tail like a woodpecker does, such as this male Malabar Grey Hornbill (above, left), the male Helmeted Hornbill (centre) cannot do this with its elongated tail and perhaps its heavy head, so it is restricted in choice of nest to one with a nice perch such as a broken off branch or a tree knot. Other species like the male Malabar Pied Hornbill (right) might also find a perch convenient.

Niranjan Sant (2), Atsuo Tsuji (centre)

been described. These range from strenuous allopreening of the female by the male until she crouches for copulation, as in the ground-hornbills, to repeatedly jumping back and forth over the female by the male, as in some small *Tockus* and large *Bycanistes* and *Buceros* species. Most of the copulation in Great Hornbill and White-throated Brown Hornbill have been observed after the female emerges from sealing work.

Preliminary sealing at the nest also starts at about this time, the female either closing up cracks and grooves on the outside or partly or entirely closing the entrance from within. By preference, most hornbills choose as small a nest entrance as possible, and, where available, one that already resembles a vertical slit. In most African species, the female uses mud collected near the nest, if she is working from the outside; but, once within, she uses mainly her own droppings or food remains. Generally, the male does not assist, but in a few small *Tockus* hornbills the male sometimes brings lumps of mud in his bill tip, while in *Bycanistes* and *Ceratogymna* hornbills the male even swallows soil, which is then formed into

sticky pellets in his gullet and regurgitated to the female. Most of the Asian species use less mud, with little help from the male; females of at least 13 species seal the nest entrance from inside the nest using mainly their droppings and regurgitated food, except for the genus *Anthraceroceros* whose sealing material may comprise up to 90% mud which is provided by the male.

As soon as the female has been fertilised and attained breeding condition, she seals herself into the nest. The male has no means of forcing the female to enter or of preventing her exit. The nest entrance is normally sealed to form an elongated vertical slit, which may be important in the separation of warm and cool airflow through the nest.

Sealing of the entrance hole can be completed within a few hours, taking at most a few days. The female then sits in the nest for a pre-laying period of about four to seven days, rarely extending to just over three weeks. Thereafter, the eggs are laid at intervals that range from one day in the case of small species, to about five days for large species. Hornbills are remarkable for the long time that elapses

between the final copulation, just before the female seals herself inside the nest, and the laying of still-fertile eggs. With many other bird species, the viability of the sperm, and hence the chances of fertile eggs, decrease steeply within a few days of the last copulation. Among hornbills, fertility can remain high, for at least three weeks in some species, presumably facilitated by qualities of the male's sperm and its storage vesicles in the female's oviduct.



Most of the Asian species use little mud for sealing, except for the *Anthraceroceros* such as this Malabar Pied Hornbill (top). Here, mud is collected by both the male and the female (above) as these images from Sri Lanka illustrate. Pathmanath Samaraweera

BREEDING ECOLOGY

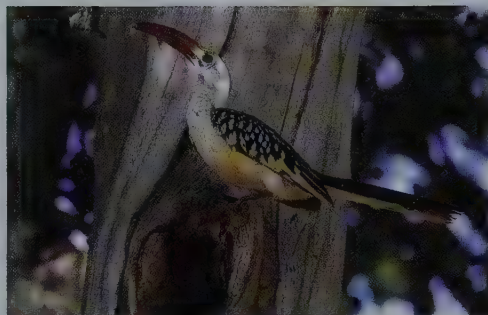
Egg-laying

Clutch sizes range from just one or two eggs, for the large species, to as many as eight for some small *Tockus* species. The eggs of all hornbill species are white, with a pitted shell and, usually, a rather elongated oval shape. They vary greatly in size: those of the Red-billed Hornbill, about 34 x 24 mm, representing one of the smallest, whereas the eggs of the Southern Ground-hornbill, at 74 x 52 mm, are the largest. For the largest Asian hornbill, the Great Hornbill, its egg is 63 x 45 mm and weighs 67 g on average.

For the majority of those species of Bucerotidae that have been observed inside the nest, it has been shown that the female starts to shed her tail feathers, or rectrices, after the first egg is laid, followed by the flight-feathers, or remiges, during the ensuing few



A female Oriental Pied Hornbill enters the nest with the male in close attendance. Ong Kiem Sian



The male feeds the female inside the nest; fruits are carried in the gullet, single prey items are carried in the tip of the bill. Here a male Northern Red-billed Hornbill of the nominate race from Ethiopia. Piotr Jonczyk



Some hornbills are co-operative breeders; the dominant male is assisted in the nest-feeding by other members of the group, the Bushy-crested Hornbill mainly by males as this photo from Budo Mountain in southern Thailand illustrates. Thailand Hornbill Project

days. Incubation takes between 23 days to 42 days, depending mainly on the size of the hornbill species in question. Since the chicks hatch in approximately the same order as that in which the eggs were laid, the effect is to produce a brood with the chicks staggered in size. This allows the largest nestlings to be more successful in competition for food and space, with the consequence that smaller chicks often die of starvation, or more rarely may be killed

and eaten by the female or siblings in the case of *Anthracoceros* and *Bucorvus*. The positive biological effect of this attrition is that the brood size is quickly and economically tailored to match the available food supply.

The male brings food to the nest throughout the nesting cycle. Among the co-operative breeders, he is assisted in this task by most members of the group. Provisioning rules vary among species. For example, dominant female White-throated Brown Hornbills in Thailand will apparently not allow subordinate females to feed the brood, while in Bushy-crested Hornbills all individuals sometimes assist at the nest, among White-crowned Hornbills only an additional female, and for Southern Ground-hornbills all group members except for the youngest. Animal food is sometimes transported to the nest in the bill, carried either as single items, as with most small *Tockus* hornbills, or as several items together, as is the case with ground-hornbills and sometimes Monteiro's Hornbills, but most other frugivorous hornbill species transport food as multiple items in the gullet. With the latter method, the multiple items are regurgitated one at a time from the gullet back to the tip of the bill, and then passed singly into the nest. On occasions, however, an extra item, such as a juicy protein-rich animal, is kept in the bill tip and presented before the main load of fruits.

Meanwhile, inside the nest the nesting female is far from passive and, indeed, has an active metabolism. This is necessary when the nest temperature drops below or rises above the thermo-neutral range of about 17–30°C. Temperature and humidity gradients inside the nest for a sample of small and large hornbill species during female imprisonment were studied in Khao Yai NP and were found to vary between 22–27°C and 65–100%, respectively.



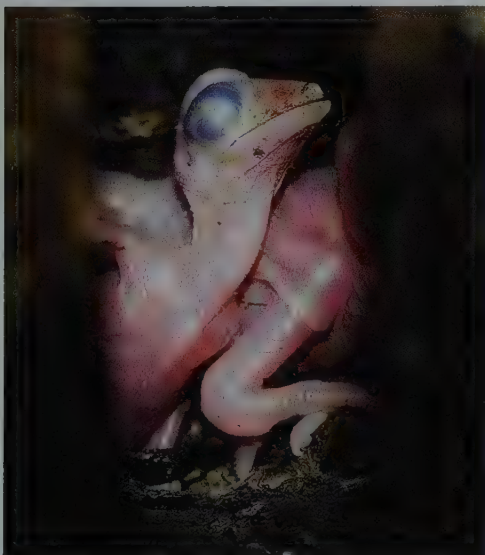
A look into the private life of an Oriental Pied Hornbill from Khao Yai NP in Thailand; the female lays three eggs but it gets crowded in the nest later in the nesting cycle as the chicks develop and grow. Atsuo Tsuji

BREEDING ECOLOGY

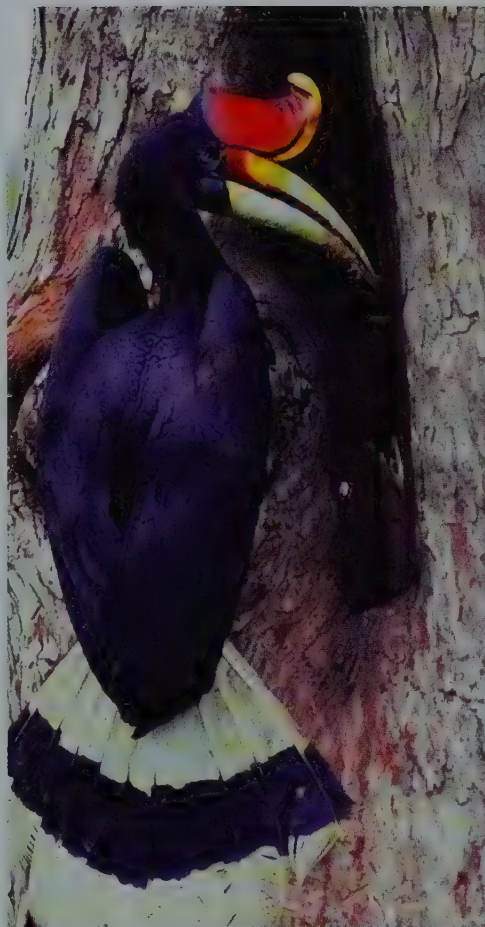
The chicks emerge

The newly hatched chick is altricial, with pink skin and closed eyes. The young chick begs weakly for food with soft cheeping calls, and is fed directly by the female with whole food items, be they fruit or animal.

When the chick is about ten days old, the eyes start to open, the feather quills begin to emerge from beneath the skin and in some species the skin colour darkens to the adult colour. When the chick is about one-third grown, it reaches the 'porcupine stage', the encased quills break open and the feathering then quickly covers the body. During studies of a Great Hornbill chick in the wild, flight and tail feathers appeared at 30 days old but body plumage did not appear until 40 days old around the head. The flight and tail feathers were fully developed by the age of about 60 days, whereas the body plumage developed



All newly hatched hornbill chicks share the same characteristic, they are altricial, with pink skin and closed eyes; only when they are about ten days old, the eyes start to open. This is a chick of a Crowned Hornbill. The shorter upper mandible of the newly hatched chick is characteristic of hornbills, and of the closer hoopoe and coraciiform relatives. Hugh Chittenden



When the chick is a few weeks old, it can sit up and beg for food from the male as can be seen here; that is when the female for some groups such as the *Buceros* genus, including this Rhinoceros Hornbill from Johor in Malaysia, will prepare to break out and help the male with the feeding. Morten Strange

later. By about the same time as the feathering emerges from the quills, the legs have attained almost full size. This enables the chick to sit up well, to take its own food at the entrance, and to squirt out its droppings. In some species, from small *Tockus* to large *Buceros*, it is at about this stage that the female breaks out of the nest and leaves the oldest chicks to re-seal the entrance themselves, which they do by using



For the Great Hornbill in the *Buceros* genus, the chick is left alone in the nest after the female leaves, and has to find its own way out into the world when it is ready, closely guarded by the parents nearby.

Thailand Hornbill Project

their droppings and any food remains. Chicks of either sex carry out the task of re-sealing the nest entrance, although in later life males will never again enter a nest cavity. At the end of the nesting cycle, as the chicks themselves fledge in sequence with their age and development, the younger ones also re-seal the nest if they are not ready to emerge with their older siblings. In Asia, re-sealing of the nest by

a chick has only been observed for Great and Rhinoceros Hornbill.

The duration of the nestling period varies according to the size of the species. There is also individual variation in growth and feeding rates, so that the time spent by the young in the nest ranges from 39–50 days for the smaller species to 72–96 days for the larger ones. In some species, such as the ground-hornbills, the small *Tockus* hornbills and the three *Buceros* hornbills, where the female usually emerges from the nest when the chicks are about one-third to half grown; depending on the size of the species, this is about 42–112 days after she initially sealed herself inside the nest. In all other species, the female emerges more or less simultaneously with the chicks at the end of the nesting cycle; in the case of the large Wreathed Hornbill, this means that she has remained in the nest for up to 137 days, or more than four months. Among Asian hornbills the exceptional female Helmeted Hornbill has the longest confinement of up to 180 days (average 140 days).

Breaking out

When the female or chicks are ready to leave the nest, the sealing material is pecked away from within, using the bill. This process usually takes only a few hours, and sufficient material is removed just to enable the bird to emerge. Emergence is generally achieved in the same manner as when initially entering the nest: the hornbill pushes out first the head, then one wing ahead of the body, and finally draws the other wing and the tail along behind, all the while scrabbling with the feet on the rim of the entrance hole. The female and chicks fly immediately on emergence, and they do not re-enter the nest until a subsequent season. The youngsters remain under cover near the nest for a few days or weeks, practising and developing the skills of flying, and being fed



A female Wreathed Hornbill, *Rhyticeros* group, emerges with the chick; here she squeezes out of her prison after a confinement that might have lasted up to 4 ½ months. Atsuo Tsuji

at intervals by their parents. They then join the adults on foraging expeditions, and they also start to develop their own ability to feed themselves and avoid predators.

Nesting success has been recorded for only a few hornbills. For four small *Tockus* species in southern Africa, 90–92% of nesting attempts were successful in fledgling at least some chicks. This was higher than the success rates of other hole-nesting birds in the same habitats, suggesting that a degree of protection was perhaps conferred on the nest by the sealed entrance. On the other

hand, the proportion of chicks fledging from eggs that hatched was highly variable, ranging from 39% to 100%. This was due mainly to chick starvation, which depended on fluctuations in rainfall and associated food availability during the nesting cycle. During studies in Thailand, chicks fledged from 87% of nests of the Great Hornbill into which a female had been recorded to seal herself, while the corresponding figure for Wreathed Hornbill was 78%. Overall in Thailand, the annual nesting success varies from 55–98% of sealed nests. ■

SOCIAL LIFE

Most hornbill species are usually encountered as pairs, an adult male and an adult female. Where they are found in small groups, these are either family units, i.e. a pair with their offspring, or members of a co-operative group, that is in most cases led by a dominant alpha pair with subordinate adults and/or offspring as 'helpers'. Therefore, hornbills can be termed as 'social birds'.

A model of fidelity?

There is probably a good reason why so many hornbill species occur as pairs. When nesting, the female retires into the nest cavity and relies on the male and group to deliver food to her and later their growing chicks. This means that the breeding female in the nest is totally reliant on the male for her own survival and that of her offspring, and so she must win and have complete 'trust' in her mate. In an ideal world, one of the best ways to cement this 'trust' is to ensure that the male has complete certainty about the paternity of the chicks, so that all his efforts are guaranteed to augment maximally his so-called genetic 'fitness', the contribution that he makes as ancestor to the next generation of his species. The female has the same genetic 'goal', to ensure her optimal genetic contribution to the next generation, and she can attain this best by being a faithful and diligent partner, bearing as many of his eggs as possible and raising them to fledglings. So sure is she of her mate, that she entrusts him with, maybe even exploits him for, the bulk of her annual moult, loading him with most of its energetic requirements by dropping all her large wing and tail feathers and re-growing them with some of the nutrients delivered by her partner before she emerges again, triumphant, from the nest. Should the male abandon the female while she was in the nest, she could break out of the nest cavity, but



Hornbills live mostly in pairs, and some species such as the Rhinoceros Hornbill are even claimed to mate for life, something that is in fact hard to prove. This is a male visiting its incarcerated partner with food. Thailand Hornbill Project



Both male and female benefit from the hornbill's nesting arrangement, and it has been speculated that the male is as much a captive in this relationship as the female; here a male Wreathed Hornbill feeds his partner inside a nest cavity prior to sealing in Khao Yai NP. Narong Suwannarong

her offspring would perish and she might too, since she would be unable to fly for a period until her new wing feathers grow out.

Of course, the real wild world is rarely ideal for any animal, and so various exceptions are found to this simplistic explanation. In only one small species, Monteiro's Hornbill, has paternity been tested thoroughly, with a perfect fit of 100% paternity to our model, one of the few instances among birds of such a high score. The same positive results have been recorded for a few pairs of the larger Rhinoceros and Great Hornbills, but with much smaller samples tested so far. However, in a few groups of Southern Ground-hornbills, paternity was not confirmed for some offspring, and their nesting biology suggests either an exception to our model, or a need for wider testing of other species with different details of their breeding behaviour.

Ground-hornbills are the only hornbills in which the female does not seal herself into the nest, although otherwise her permanent attendance at the nest and provisioning by the male and his helpers is indistinguishable from nest-sealing hornbills. Two special behaviours only reported so far from ground-hornbills suggest that males may be suspicious of their paternity and that females are sometimes 'unfaithful'. First, prior to nesting, when the female is being courtship-fed to build up her reserves, the alpha male, her prospective partner, tries to exclude secondary adult helper males from feeding her, but not always with success if he does not immediately satisfy her demands, as when a secondary male is lucky enough to catch a more attractive food item. Second, ground-hornbill copulation is an obvious affair, where the male heavily grooms his partner into a crouching position

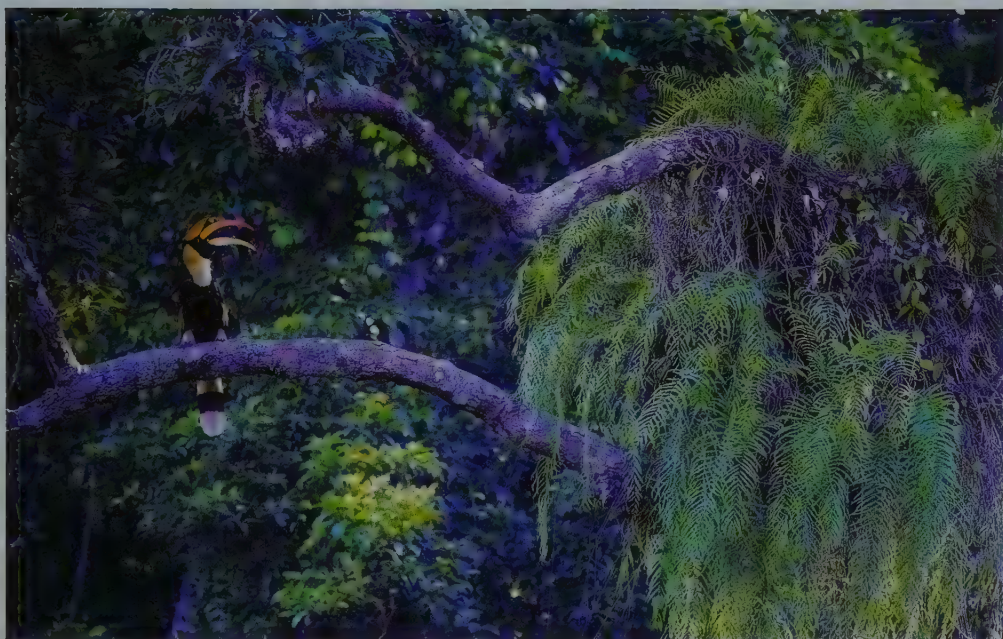
for mounting, and is usually conducted on an open perch visible to other members of the group. Only then, when the alpha male is otherwise occupied, do the subordinate and immature males become very excited and hassle him, a rare breakdown of the stable social hierarchy and 'respectful' behaviour normally apparent in groups.

In co-operative species, the White-throated Brown Hornbill presents a good example in social behavior. The members of the group show 'reciprocal altruism' in helping the alpha breeding pair gain an advantage over non-breeders by occupying a nest site. To successfully fledge chicks in a co-operative species, the imprisoned female White-throated Brown Hornbill, and later the chicks, completely rely on the alpha male and later the helpers, which are male subordinates or immatures in the group, for feeding and expelling intruders, whereas breeding pairs without helpers tend to have low chick fledging success. Such a social strategy in hornbills is really considered as a type of 'mutualism'. Although the reciprocating individuals could suffer the loss of short-term breeding opportunities, then eventually they gain more reproductive success. Mutualism is restricted to cases in which the donors definitely lose breeding opportunities for a long time, due to a long period of engagement in assistance, while the recipients gain high offspring survival.

Communications

Hornbills tend to communicate visually or vocally. However, for those that are forest inhabitants, communication among conspecifics and sympatric species seems to be dominated by vocalisations or calls. A number of hornbill species have elaborate calls and displays that precede breeding and these may be important in tightening the bond between

SOCIAL LIFE



Hornbills are vocal birds, and their loud calls play an important part in socialising among individuals. Clockwise from top left: Great Hornbill, Black-and-white-casqued Hornbill, Malabar Pied Hornbill and Crowned Hornbill, all males. Morten Strange, Tadasz Rosinski, Christoph Moning, John Hornbuckle

members of a new pair or renewing the bond between established pairs. However, often the same or similar displays serve in territorial defense during the rest of the year, especially for those species that are sedentary and maintain year-round home ranges. This makes it difficult to know exactly what proportion of the communications signal spatial defense versus pair-bonding. For example, adult ground-hornbills in a group utter their deep booming calls at dawn every day of the year, but the different pitches of males and females also signal the sexual composition of the group. Similarly, a male Great Hornbill leads with loud normal calls every morning throughout the year, but outside the breeding season the female normally joins in with duet calls. Since hornbills are long-lived, changes in pair members are probably rare, so this calling is probably a signal by both sexes of occupancy of their strictly defined territory, as revealed by immediate 'invasions' as soon as a member of a pair or group fails to call one morning.

In the breeding season, after the female has imprisoned herself, vocal communication between the mates predominates over visual communication. For instance, a number of breeding males of Great, Wreathed, White-



Visual displays are also important for many hornbill species; here a Silvery-cheeked Hornbill male from Tanzania signals to other members of the group.

Werner Suter

throated Brown and Oriental Pied Hornbills utter calls when they enter the nest area, females usually calling back. This may signal that it is safe for the male to come to the nest. Females are often heard calling for her mate as well. Besides vocal communication, noises produced by the male's whooshing flight can signal the chick to be alert and start making begging calls. On several occasions at Great Hornbill nests, if the father quietly sneaks in to perch in front of the nest without the sound of wing-beats, it is often threatened by aggressive roaring calls by the chick. In this case, the chick will calm down and accept the food after recognising its father visually. The chick was observed to refuse the food fed by a stranger by throwing out such food.

Elaborate calls and visual displays are also common in *Tockus* hornbills, while they do play a role in territorial proclamation throughout the year, they are much more frequent in the build-up to nesting when pair-bonding is important. Most other hornbill species also call together as pairs or groups, but few have any remarkable display activities, probably because they are birds of dense forests where visual signals are least effective. Several jerk their heads back as they call, like the Wreathed Hornbill, and others raise the bill skywards as they call, like Rhinoceros and Great Hornbills. The Rufous-necked Hornbill will jerk its tail up at the end of calling, and maybe most spectacular of all is the Helmeted Hornbill which sometimes progress from calling to casque-butting with other individuals at perch or in flight.

Roaming around

Although hornbills live mostly in pairs, and some species are even claimed to mate for life (with little real evidence so far), the chances are that one partner will die before the other and that the surviving partner will search



Hornbills such as the African Grey Hornbill, here a male, of the dry savanna habitat often face years when droughts occur; when this happens, they become nomadic in search of patches with the best food. Thierry Helsens

for a new mate. Surplus adults are usually available in any healthy population, although they are often difficult to detect since they live a roaming life, searching and waiting for vacancies to appear. In some of the larger species, such as Rhinoceros, Great, Wreathed, Black-casqued and Helmeted Hornbills, it is common to find roaming flocks of sub-adult and non-breeding adult birds, while in species living in co-operative groups, these non-breeding sub-classes are immediately evident among the helpers that assist the alpha breeding pair. It is also likely that some pairs will separate, for all the reasons that beset any seemingly stable family, but this is difficult to prove unless both members are recognisable naturally or by having markers attached to them, such as colour rings or radio transmitters, and re-mating with a new partner is even more difficult to confirm.

All of these generalisations about how hornbills select their mates and organise their social lives have assumed that the habitat and

SOCIAL LIFE

ecological conditions are fairly stable, which is obviously not always the case. Hornbill species occupy habitats that range from arid semi-desert, like Monteiro's and Hemprich's Hornbills, to dense everwet rainforests, like various African and Asian frugivorous species. Generally, the lower the average rainfall, the higher the annual variance; so that hornbills of drier savanna habitats often face years when the rainfall fails or droughts occur. When this happens, they can no longer remain on their chosen territories and will have to band together in flocks and become nomadic in search of patches with the best food. This applies to African Grey Hornbills in West Africa or Red-billed Hornbills in Southern Africa. Then, when conditions return to normal, they can gravitate back to their preferred sites until the next round of deteriorating conditions arrives.

The same patterns apply even to frugivorous hornbills in the semi-deciduous forests of Africa and Asia, where in the drier seasons they experience fruit shortages and all or part of the populations move widely in search of sustenance, such that numbers in any given area may fluctuate seasonally by as much as 20-fold, as for African wattled- and white-rumped hornbills (genera *Ceratogymna* and *Bycanistes*) or the huge non-breeding flocks of Asian Plain-pouched Hornbills. Even in the everwet and evergreen rainforests, fluctuations in the rainfall through the year cause wetter and drier periods, but here it is the drier periods that are preferred for nesting as this is when a majority of trees bear fruit. However, in rainforests, fruiting is not a seasonal or even an annual event for all tree species, and so sometimes the hornbills have to skip breeding for one or more years until the next period of abundance, or synchronised 'mass' fruiting, comes around.



Other hornbills, especially large frugivorous rainforest species, regularly flock in search of optimal feeding and roosting sites, such as these Wreathed Hornbills from Thailand. Narong Suwannarong



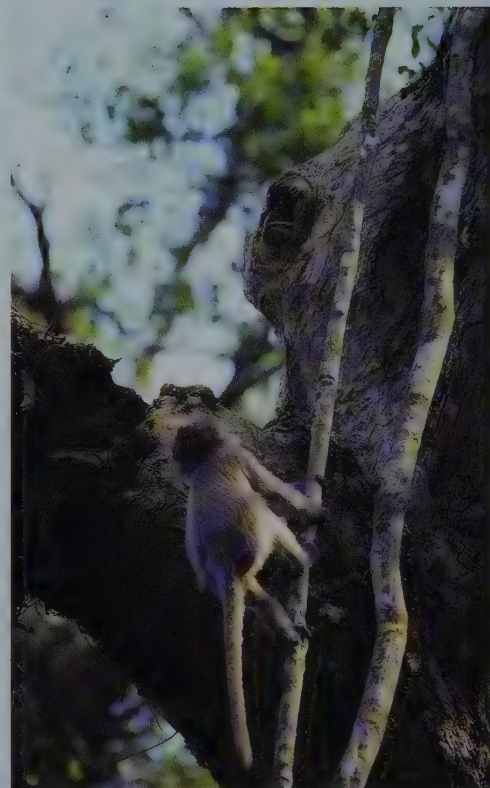
There are confirmed cases in Thailand where hornbills preyed on Greater Racket-tailed Drongo *Dicrurus paradiseus*, but here this drongo fearlessly attacks a Plain-pouched Hornbill on the way to its nest fearlessly. Chien Lee

Survival

Fortunately, most hornbill species are relatively long-lived, typical of birds living in the tropics and southern hemisphere, and of large body size, with the life span of even small-hornbill species estimated as a decade or more, and of larger species at 4–5 decades. This allows them to survive through the bad times, reproduce during the good times and still maintain relatively stable and healthy populations. The largest hornbill species seem able to do this, even though a number of them raise only a single chick at a time. The smaller species are able to raise several chicks at a time; and Monteiro's Hornbill, resident in the most extreme habitat of any hornbill with rainfall of less than 100 mm annually in some areas, may be capable of raising up to eight chicks at a time during exceptional seasons; this makes up for the drought years, when it raises only a single chick or fails altogether.

Neighbours and competitors

Hornbills do not live alone within their chosen habitats, and so their social lives involve all sorts of interactions with other animals, from potential predators to competitors for food sources and nest sites. The basic rule for these interactions is that relative size matters. Larger hornbills are vulnerable to fewer predators and dominant over smaller animals in competitive interactions, and vice versa for the smaller hornbill species. Neighbouring and competitive hornbills may influence nest spacing. Nearest-neighbour distance among nests of Great Hornbills, the largest among Asian hornbills, is 1,000 m on average (range 160–2,300 m), yet the same Great Hornbill may nest close to other sympatric species, as close as 5 m. These events suggest hornbills develop tolerant behaviour among species as mentioned in the previous chapter (Plain-



Hornbills do not live alone within their habitats; their social lives involve all sorts of interactions with other animals. While incarcerated, this Rhinoceros Hornbill female in Malaysia has to entertain the curiosity of a Plantain Squirrel *Callosciurus notatus* (left), while this investigative Banded Leaf Monkey *Presbytis femoralis* (right) has spotted a Rufous-necked Hornbill poking out its bill from inside the nest in Huai Kha Khaeng WS. Morten Strange

pouched and Oriental Pied Hornbills using old woodpecker hole in the same tree in the same breeding season). Oriental Pied Hornbill appears to be one of the most tolerant species.

Insectivorous and carnivorous hornbills are generally strictly territorial as a species, usually throughout the year but especially when breeding. This makes intra-specific feeding competition low, since it is inefficient to have to share small animal prey that has to be hunted for over a wide area of habitat. Competition with other animal species for prey remains a possibility, although this is reduced by each species having its own special foraging niche and techniques.

Frugivorous hornbills often have to share fruits, as they ripen on a particular tree, and so here competition is regularly observed, not only between hornbills of the same and other species, but also with other sympatric animals such as fruit pigeons and parrots or monkeys and squirrels. Up to 15 competing species have been recorded at favoured tree species.

With 57 species and a wide variety of habitats, hornbills show considerable variation in how they organise their social lives. Many details still need to be explored and documented in some of the world's most fascinating wild environments, from African savannas to Asian rainforests. ■

HOW TO USE THIS BOOK

The following 160 pages are a species-by-species account of all the 57 full species of hornbills currently recognised by our sources on page 212. Taxonomy, sequence and nomenclature have all been updated. There are more details in each species entry; here we would like to highlight that compared to the latest previous complete account of the Bucerotiformes order (Kemp, 2001), these recent changes to English names have been made:

- White-throated Brown Hornbill *Ptilolaemus austeni* was before Austen's Brown Hornbill,
- Samar Tarictic Hornbill *Penelopides samarensis* has been split from Mindanao Tarictic Hornbill *Penelopides affinis*,
- Abyssinian Ground-hornbill *Bucorvus abyssinicus* was Northern Ground-hornbill,
- Jackson's Hornbill *Tockus jacksoni* has been split from Von der Decken's Hornbill *Tockus deckeni*,
- White-crested Hornbill *Tropicranus albocristatus* was Long-tailed Hornbill,
- Black-and-white-casqued Hornbill *Bycanistes subcylindricus* was Grey-cheeked Hornbill, and
- White-thighed Hornbill *Bycanistes albotibialis* has been split from Brown-cheeked Hornbill *Bycanistes cylindricus*.

Distribution lists major range countries and, for the Asian species, usually all countries.

The **Distribution map** should help clarify range. Please keep in mind that the maps show total range, not necessarily just the specific sites with suitable habitat, which for most species would be much smaller and highly fragmented areas. The nominate race is coloured **green**. For second and third subspecies, **blue** and **yellow** was used.

Description has been kept brief and mainly includes diagnostic features and sexual differences; we have checked and updated all available data regarding size and weight.

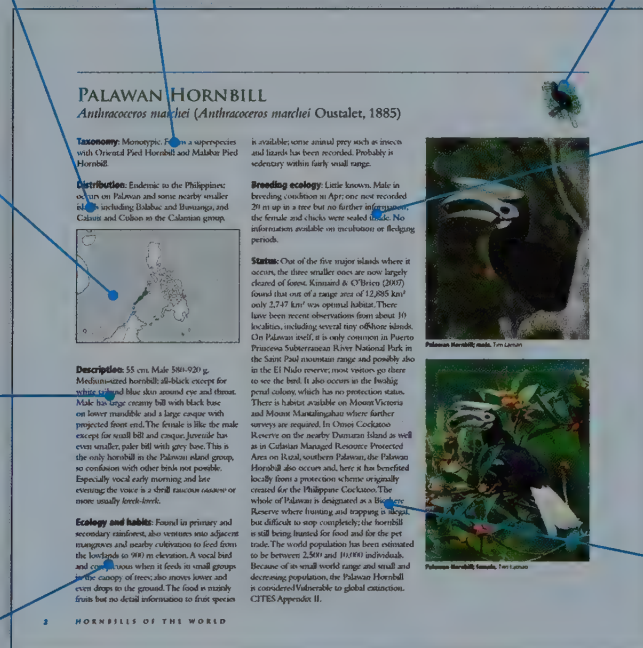
Ecology and habits provide a brief account of what we know about the species, its habitat preferences and general habits, including feeding and social habits.

The **Taxonomy** paragraph accounts for relationships and possible subspecies issues. Hornbill taxonomy is a work in continuous progress; more changes will be made as new data emerge.

The **watercolour illustration** provided for each species by Preeda Thiensongrusamee from the Thailand Hornbill Project shows a male of the nominate race.

The **Breeding ecology** paragraph accounts for what we currently know about the nesting biology of the species, and the reader will find much new information coming to light here. We do not provide citations for every statement, and much of the new information is based on our own research. Works listed in the References on page 212 include more details of sources; an important resource is the proceedings published after each of the five International Hornbill Conferences arranged so far.

Finally, the **Status** paragraph has been of much concern to us, as we here account for the often dwindling population of the species and its current conservation status.



The **photographs** have been provided by a large number of contributing photographers, 62 in total. We have selected quality images showing the bird in its natural habitat; only two were taken in captivity and are included to show important plumage variations otherwise not available. Unless otherwise stated, the photo shows an adult bird. Sometimes, but not always, we were able to include the location where the photograph was taken, and then mainly where subspecies plumage and morphology variations are an issue. The photographs were cropped and brightened as required; in a few we removed some obviously disturbing blotches by digital editing, but mainly the photographs were left as they were submitted, with colours and surrounding habitat features as they are. This way we hope to bring out the authentic beauty of the many different hornbill species and forms, and the gorgeous world they inhabit.



World hornbill distribution (See pages 45 and 117 for range countries by species)



SPECIES ACCOUNTS AFRICA

AFRICAN HORNIBILLS RANGE COUNTRIES

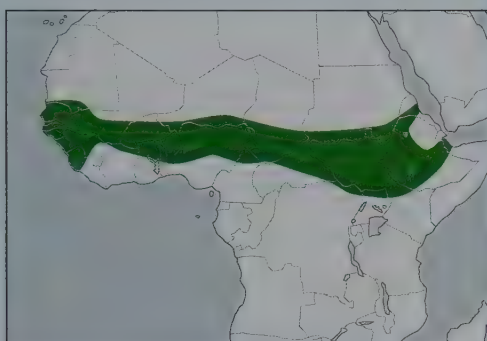
		Angola	Benin	Botswana	Burkina Faso	Burundi	Cameroon	Central African Rep.	Chad	Republic of Congo	Côte d'Ivoire	Dem. Rep. Congo	Djibouti	Equatorial Guinea	Eritrea	Ethiopia	Gabon	The Gambia	Ghana	Guinea	Guinea-Bissau	Kenya	Liberia	Malawi	Mali	Mauritania	Mozambique	Namibia	Niger	Nigeria	Rwanda	Saudi Arabia	Senegal	Sierra Leone	Somalia	South Africa	Sudan	South Sudan	Swaziland	Tanzania	Togo	Uganda	Yemen	Zambia	Zimbabwe	Total for species	
Abyssinian Ground-hornbill	<i>Bucorvus abyssinicus</i>		1		1		1	1	1		1	1			1	1		1	1	1	1	1			1	1			1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	25	
Southern Ground-hornbill	<i>Bucorvus leadbeateri</i>	1		1		1						1										1		1			1	1				1						1	1			1	1		1	1	15
Monteiro's Hornbill	<i>Tockus monteiri</i>	1																										1																			2
Red-billed Hornbill	<i>Tockus erythrorhynchus</i>	1	1	1	1		1	1	1		1				1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	34
Southern Yellow-billed Hornbill	<i>Tockus leucomelas</i>	1		1																				1			1	1								1			1						1	1	9
Eastern Yellow-billed Hornbill	<i>Tockus flavirostris</i>											1		1	1							1													1		1	1		1		1				9	
Von der Decken's Hornbill	<i>Tockus deckeni</i>															1						1													1											4	
Jackson's Hornbill	<i>Tockus jacksoni</i>															1						1													1							1				4	
Hemprich's Hornbill	<i>Tockus hemprichii</i>											1		1	1							1													1			1				1				7	
African Pied Hornbill	<i>Tockus fasciatus</i>	1	1		1		1	1		1	1	1		1		1	1	1	1	1	1	1	1					1			1		1	1				1		1	1						21
Crowned Hornbill	<i>Tockus alboterminatus</i>	1		1		1						1				1						1		1			1	1				1			1	1		1	1	1	1	1	1	1	1	18	
Bradfield's Hornbill	<i>Tockus bradfieldi</i>	1		1																								1																	1	1	5
Pale-billed Hornbill	<i>Tockus pallidirostris</i>	1										1													1			1																	1	6	
African Grey Hornbill	<i>Tockus nasutus</i>	1	1	1	1	1	1	1	1		1	1		1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	40
Red-billed Dwarf-hornbill	<i>Tockus camurus</i>	1					1	1		1	1	1		1		1		1	1	1		1						1						1				1					1			15	
Black Dwarf-hornbill	<i>Tockus hartlaubi</i>	1					1	1		1	1	1		1		1		1	1	1		1							1					1				1				1	1			16	
White-crested Hornbill	<i>Tropicranus albocristatus</i>	1	1				1	1		1	1	1		1		1		1	1	1		1						1						1								1	1			16	
Yellow-casqued Hornbill	<i>Ceratogymna elata</i>						1			1										1	1	1	1					1			1	1								1					10		
Black-casqued Hornbill	<i>Ceratogymna atrata</i>	1					1	1		1	1	1		1		1		1	1	1		1						1									1			1	1					16	
Piping Hornbill	<i>Bycanistes fistulator</i>	1					1	1		1	1	1		1		1		1	1	1	1	1						1						1	1				1		1	1				18	
Trumpeter Hornbill	<i>Bycanistes bucinator</i>	1	1		1							1										1	1		1			1	1																1	1	13
Silvery-cheeked Hornbill	<i>Bycanistes brevis</i>													1	1							1	1			1																			1	1	9
Black-and-white-casqued Hornbill	<i>Bycanistes subcylindricus</i>	1				1	1	1		1	1	1		1		1		1	1	1		1	1					1	1					1					1		1	1	1				20
Brown-cheeked Hornbill	<i>Bycanistes cylindricus</i>									1										1	1		1											1							1					6	
White-thighed Hornbill	<i>Bycanistes albotibialis</i>	1					1	1		1		1		1			1																					1				1				10	
Total for country		17	5	7	4	5	12	11	3	8	12	14	2	8	6	9	8	4	12	12	6	12	10	8	3	3	8	8	3	12	4	1	6	12	7	6	4	15	6	10	11	16	1	9	8		

ABYSSINIAN GROUND-HORNBILL

Bucorvus abyssinicus (*Buceros abyssinicus* Boddaert, 1783)

Taxonomy: Monotypic.

Distribution: Occurs in Africa north of the equator, from south Mauritania and Guinea east to Ethiopia and north-west Somalia, and south to Uganda and northern Kenya where it just overlaps with its southern congener.



Description: 90–100 cm. Male 4000 g. Large hornbill with black plumage and white primaries obvious in flight. Bill is black with an elevated cowl-like casque and yellowish base on upper mandible. Both sexes have bare skin around eyes blue, but male has bare throat pouch red with blue patch; females' pouch is all-blue. Juvenile has browner plumage with black flecks on white primaries, only slight casque on bill and dull version of adult facial skin colours. Sex is clearly evident within 1 year; full maturity is reached after 3–4 years. The call is a series of deep booming notes *uu-h uu-h* or *uu-h uh-uh-uh*.

Ecology and habits: Occurs in savanna and sub-desert grasslands with some scrub; generally prefers drier and less wooded areas than Southern Ground-hornbill but is much less studied. It extends into hilly and rocky terrain, and in Ethiopia recorded up to 3,257 m elevation. It is usually seen walking slowly on the ground, as a pair or a small family group with one or two immatures. It feeds mainly on



Abyssinian Ground-hornbill; female, Ethiopia. Adriaan Dijkse



Abyssinian Ground-hornbill; male carrying prey. Philip Stapelberg

animals that it finds in the grass such as beetles, larvae, spiders and vertebrate prey like lizards and tortoises. It also feeds on fallen fruits and seeds, and may be seen gathering with other scavengers at carrion. At optimal feeding sites a small flock of up to 20 individuals might gather, sometimes with a predominance of females. The pair is apparently sedentary, and juveniles stay in the family home range for



Abyssinian Ground-hornbill; two immatures, Mali. Thierry Helsens



Abyssinian Ground-hornbill; immature male, Ethiopia. Marie-France Granouillet



Abyssinian Ground-hornbill; male, Ethiopia. Raphael Jordan

several years, but apparently not an obligate cooperative breeding species like its congener. In captivity a pair lived for at least 40 years.

Breeding ecology: The period of egg-laying varies across its enormous range; in the west it is mainly Jun–Aug, from Jan onwards in Nigeria and Uganda, and as late as Nov in Kenya. The nest is a natural cavity in a large



tree, often a Baobab, but palm trees, rock holes or man-made logs and baskets have also been used. The male brings dry leaves to line the nest, but the entrance is not sealed. The female enters the nest and is fed from the outside by the male. The nesting is not studied well in the wild, but in captivity 2 eggs are laid 4–5 days apart; the younger chick usually starves to death within the first week and only one ever fledges. Incubation is 37–41 days; the female leaves 21–33 days after hatching and helps the male to feed the chick, which leaves the nest itself when it is 80–90 days old.

Status: This is a low-density species; each pair has a large home range of about 260 km². However, the range is huge, and it is widespread in many countries, including many protected areas and at least 8 national parks. The population has not been estimated, but it is believed to be substantial and stable. Therefore the species is not considered threatened with global extinction.



Abyssinian Ground-hornbill; female flying. Pete Morris



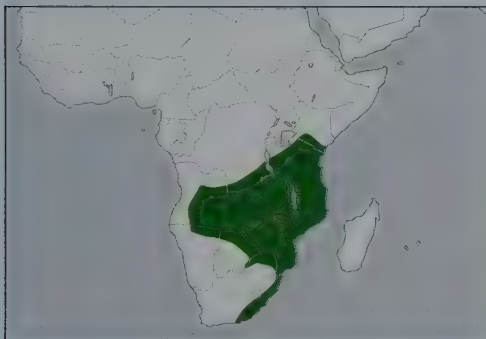
Abyssinian Ground-hornbill; immature female, adult male and adult female, Ethiopia. Adriaan Dijkse

SOUTHERN GROUND-HORNBILL

Bucorvus leadbeateri (*Buceros leadbeateri* Vigors, 1825)

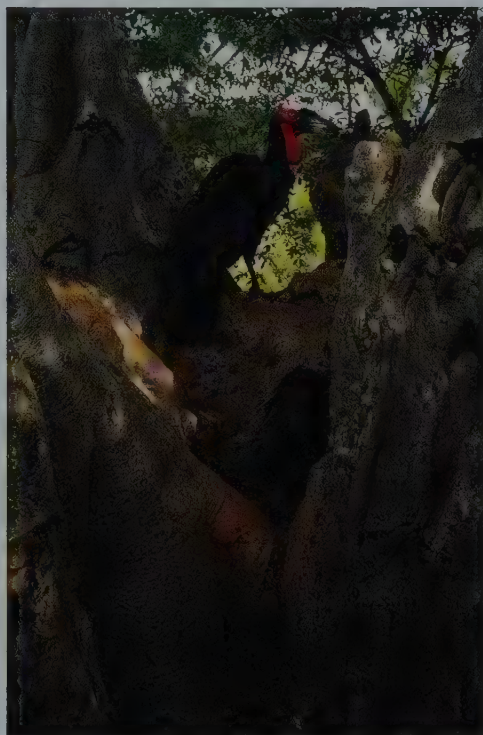
Taxonomy: Monotypic. Previously listed as *B. cafer*; this name is now considered a junior synonym.

Distribution: Occurs in Africa south of the equator, from south Kenya and Burundi, south to Angola and parts of Namibia, Botswana and South Africa. It overlaps in range with Abyssinian Ground-hornbill over a small area in northern Kenya.



Description: 90–100 cm. Male 3459–6180 g; female 2230–4580 g. The largest and heaviest of all hornbills with black plumage and white primaries obvious in flight. Bill is black with short and low black ridge casque. Bare skin around eyes and pouch is crimson red. Female is smaller than male, with variable-sized blue patch under throat above red pouch. Juvenile has browner plumage, with black flecks on white primaries, and dull grey-brown facial skin; it reaches maturity after 4–6 years. The call is a deep booming 4-note *hoo hoo hoo-hoo* somewhat deeper and slower than Abyssinian Ground-hornbill; both sexes call, in flight as well as while perching or walking.

Ecology and habits: Occurs in savanna and woodlands, generally preferring more wooded and wetter areas than Abyssinian Ground-hornbill but it also extends into adjacent open grasslands. In East Africa recorded up



Southern Ground-hornbill; adult male delivering food to a large chick in its open, unsealed nest cavity. The two species of African ground-hornbills of the family Bucorvidae do not seal their nests; this way they differ significantly from the 55 species of nest-sealing hornbills in the Bucerotidae family. Tim Laman

to 3,000 m elevation. This is a well-studied bird that is fairly easy to see in many popular East and Southern African national parks. It is usually seen walking slowly on the ground in groups of 2–9 birds, rarely up to 16 birds together when neighbouring groups meet. It feeds mainly on animals that it catches on the ground. A large assortment of prey has been recorded, mainly invertebrates such as grasshoppers, beetles, insect larvae, snails, scorpions and termites. Vertebrate prey has included frogs, rodents from mice to squirrels, hares, small birds, snakes, lizards and tortoises. It actively pursues prey on the ground or in short flights; for larger prey several members in the

group might surround it and hunt together. It uses its huge bill to dig for food and stab larger prey. It digs concealed prey out of the ground or of rhino middens and elephant dung, especially during the dry season, and also probes dead wood for larvae. It takes a few fruits and nuts, also visits kills, mainly to search for bits of carrion and associated grubs, but rarely feeds on warthog ectoparasites. It is territorial and sedentary; immatures and non-breeders, particularly males, remain with the group as helpers to the alpha breeding pair, but leave the territory from time to time, especially females, to search for vacant positions in other groups.

Breeding ecology: Egg-laying is usually after the first good rains of the summer, at the end of the year, Sep–Dec, over most of its range. The nest is a natural cavity in a large tree, less often in a rock hole and rarely in an earth bank. Readily uses artificial nest logs. The males bring dry leaves to line the nest, but the entrance is not sealed. The dominant female in the group enters the nest and is fed from the outside by the alpha male and up to 10 other members of the group (mean group size 3–5 birds). Each carries multiple food items in its bill at one time and feeds them to the female and later the chick(s). Clutch size is 2 eggs (in 85% of cases), sometimes only 1 but rarely 3 eggs. The eggs are laid at intervals of 3–5 days, rarely up to 20 days. The younger chick(s) usually starves to death within the first week, sometimes a month, and only one chick survives to fledging. Incubation is 37–43 days; the nestling period is 86 days, the female leaves the nest for the last two months to assist the group feed the chick. The juvenile will stay in the group at least until it reaches maturity after 4–5 years. A study in South Africa concluded that groups only raise, on average, one juvenile to fledging every 9 years.





Southern Ground-hornbill; sub-adult male with gerbil prey; notice remains of grey patch on bill.
Tim Laman



Southern Ground-hornbill; sub-adult male. Tim Laman



Southern Ground-hornbill; adult male with a toad and frog together with some pieces of vegetation. Hugh Chittenden



Southern Ground-hornbill; immature male with snake prey. Hugh Chittenden



Southern Ground-hornbill; immature with scorpion prey, probably a female that has not yet developed the deep violet-blue throat patch.
Tim Laman

SOUTHERN GROUND-HORNBILL



Southern Ground-hornbill; sub-adult male, close to adulthood, and a year-old juvenile yet to develop signs of redness. Morten Strange



Southern Ground-hornbill; female (left) holding insect prey with adult male in background. Notice the blue patch on red throat of female; this is a 'very blue' adult female, as opposed to 'small blue' females where the patch is often only obvious when the bill is raised to toss back food; the female's blue patch is variable in extent, and it does not appear to change with time after maturity. Lucy Kemp



Southern Ground-hornbill; a large cooperative group patrolling their territory, the adult alpha female in the second-from-left foreground, the adult alpha male in the background, a year-old juvenile trailing on the right, and four sub-adult helpers in between, probably males, but yet to show their full adult colours. Tim Laman

Status: A widespread and locally common but low-density species; the density varies from a group per 20–40 km² in northern Zimbabwe to 100–200 km² in southern Zimbabwe and South Africa. It occurs over a huge range of over 8 million km²; but within this range suitable habitat has been in decline. It can be found in several game reserves and at least seven national parks, but with small total populations due to its low density. Outside of protected areas, suitable nesting grounds can disappear because of human expansion; the savanna is converted into agriculture and settlements, causing loss of large potential nest trees and lowering of small-animal production, but in more extensive areas where livestock graze and fires open thicket habitat numbers may actually increase. In Kenya perhaps only 10% of suitable habitat remains and in South Africa the historical range has decreased by 50–70% in different provinces. In Southern Africa, African elephants may cause the reduction of nest trees. Although protected by tribal lore and included in songs and dances in some areas, it is being persecuted in others directly for breaking window glass when it attacks its own reflection, or as a superstitious token against drought or illness, or indirectly by eating poisoned bait. Collisions with and electrocution on transmission lines, and Newcastle's disease are also factors in South Africa. Feathers are used in traditional regalia in Malawi and traded for aviculture from Tanzania. Populations have decreased significantly in all range countries where data is available, including Kenya, Botswana, Zimbabwe, South Africa, Malawi and Zambia, although decline in Zambia and northern Mozambique is believed to be slower than elsewhere, and these countries are considered a stronghold for the species. Declines will continue in the future, and the species recovers slowly due to its slow reproductive rate and maturation, as well as its complex social structure. Conservation work is being carried out in South Africa, including ecological studies and a captive rearing and re-introduction programme using the second hatchling, which would die anyway under normal circumstances. Previously considered a species of Least Concern, but in 2012 it was uplisted to Vulnerable to global extinction, and in South Africa is considered Endangered, maybe even critically so.

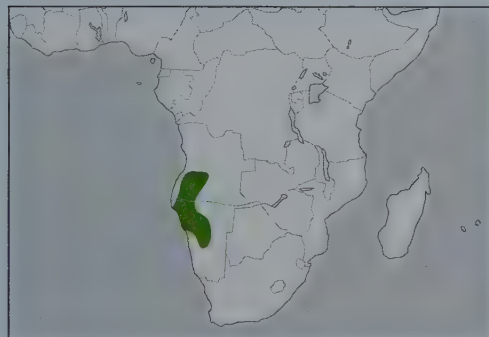
MONTEIRO'S HORNBILL

Tockus monteiri (*Toccus monteiri* Hartlaub, 1865)



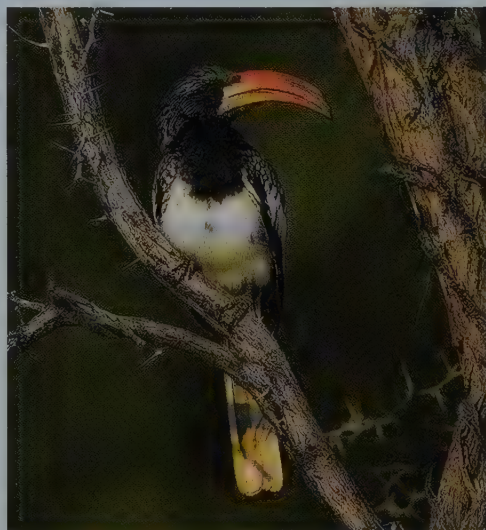
Taxonomy: Monotypic. Considered closest to Red-billed Hornbill, but also close to Southern Yellow-billed, Eastern Yellow-billed, Von der Decken's and Jackson's Hornbills, and similar in some ways to Hemprich's Hornbill, maybe convergently. In the past, southern populations sometimes separated as different subspecies *marjoriae*.

Distribution: Southern Africa from central Namibia north into south-west Angola.



Description: 50 cm. Male 370 g; female 269–423 g. Differs from other sympatric *Tockus* hornbills by combination of white-flecked grey and brown plumage, with white underparts, and reddish bill. Male has large bill, with casque ridge running almost the full bill length, and dark grey bare throat skin; female has somewhat smaller bill and shorter casque, and greenish bare throat skin. Juvenile has smaller pale-orange bill with dark brown patch at base. The call is a series of deep, hoarse chucking notes *kok-kok-kok*. During territorial display the notes accelerate and become louder, as the head-down bobbing actions with closed wings also accelerate.

Ecology and habits: Found in savanna with dry scrub and thorn-bush vegetation; it prefers stony hills and adjacent flatlands. It occurs in the driest regions of any hornbill and can live



Monteiro's Hornbill; male. Hugh Chittenden

in areas with under 100 mm of annual rainfall. Somewhat shy and wary, it feeds mainly on the ground, but hops rather than runs like its closest relatives; hunts for insects, especially grasshoppers and armoured crickets, but a wide variety of invertebrates is taken such as beetles, centipedes and millipedes, wasps and caterpillars. It also feeds on some plant matter such as fruits, seeds, flowers and bulbs that it digs out from the ground with its long strong bill. When not feeding it will rest on an elevated look-out point on a rock or a small savanna tree; the roost is in a tree or on a rock ledge if no trees are available. Where and when rainfall is plentiful it is territorial and sedentary; in drier areas it will wander outside of the breeding season in search of food, sometimes forming flocks, up to 47 birds having been recorded in one group. It will then move out of its home range and can turn up in atypical flat and sandy regions.

Breeding ecology: It starts breeding towards the end of the rainy season, about a month after the first good rainfall, during the period

Oct-Mar but mainly in the Jan-Mar period. The nest is a natural cavity in a rock face or a tree, usually a large tree found in a moister area near a river. It is monogamous and territorial; the pair will bond by spending many days at the nesting site, especially the early morning hours. It seals major external fissures and lines the nest with leaves and grass. The same site is often used year after year. After mating, the female will enter the nest cavity, and seal herself into the nest, occasionally assisted by the male. The male brings lumps of mud, and the female uses these as well as her own droppings and food pulp as cement. Like other hornbill species, this one has been observed mixing millipedes brought in by the male into the sealing material; the millipedes are believed to excrete an antibiotic chemical when crushed that helps to keep the nest hygienic. After a pre-laying period of 5–11 days, the female lays 2–8 eggs, and hatch at intervals of 2–4 days after an incubation period of 24–27 days. During the nesting period, the male feeds the female and later the chicks with up to 3 food items carried at the tip of the bill on each visit, unique within the genus. Feeding rates are about 1–3.5 visits per hour. At one nest, 70% of the food brought by the male was long-horned crickets. When the oldest chick is 19–25 days old, the female will emerge and help the male in the feeding. The chicks fledge after 43–46 days. The clutch size and the nesting success varies from year to year; it is higher in wet years when food is more plentiful. A brood of 5 fledglings has been recorded, but the overall average brood size for successful nests in Namibia is only 2.3.

Status: Although the range is under 100,000 km² and as such somewhat limited, the species is widespread and common. A survey in Namibia found that the territory for each pair was only 10–21 ha in size; the mean was 15 ha. It occurs in inhospitable and remote



Monteiro's Hornbill; immature male, Erongo region, Namibia. Paul Noakes



Monteiro's Hornbill; female. Hugh Chittenden

terrain with little human impact other than overgrazing. In Namibia it is present in some large protected areas such as the Waterberg NP, as well as Daan Viljoen Game Reserve where it breeds in artificial nesting boxes. In Namibia, it is regarded as common with a total and stable population estimated at 340,000 individuals. Considering this, the species is not regarded as threatened with global extinction.

RED-BILLED HORNBILL

Tockus erythrorhynchus (*Buceros erythrorhynchus* Temminck, 1823)

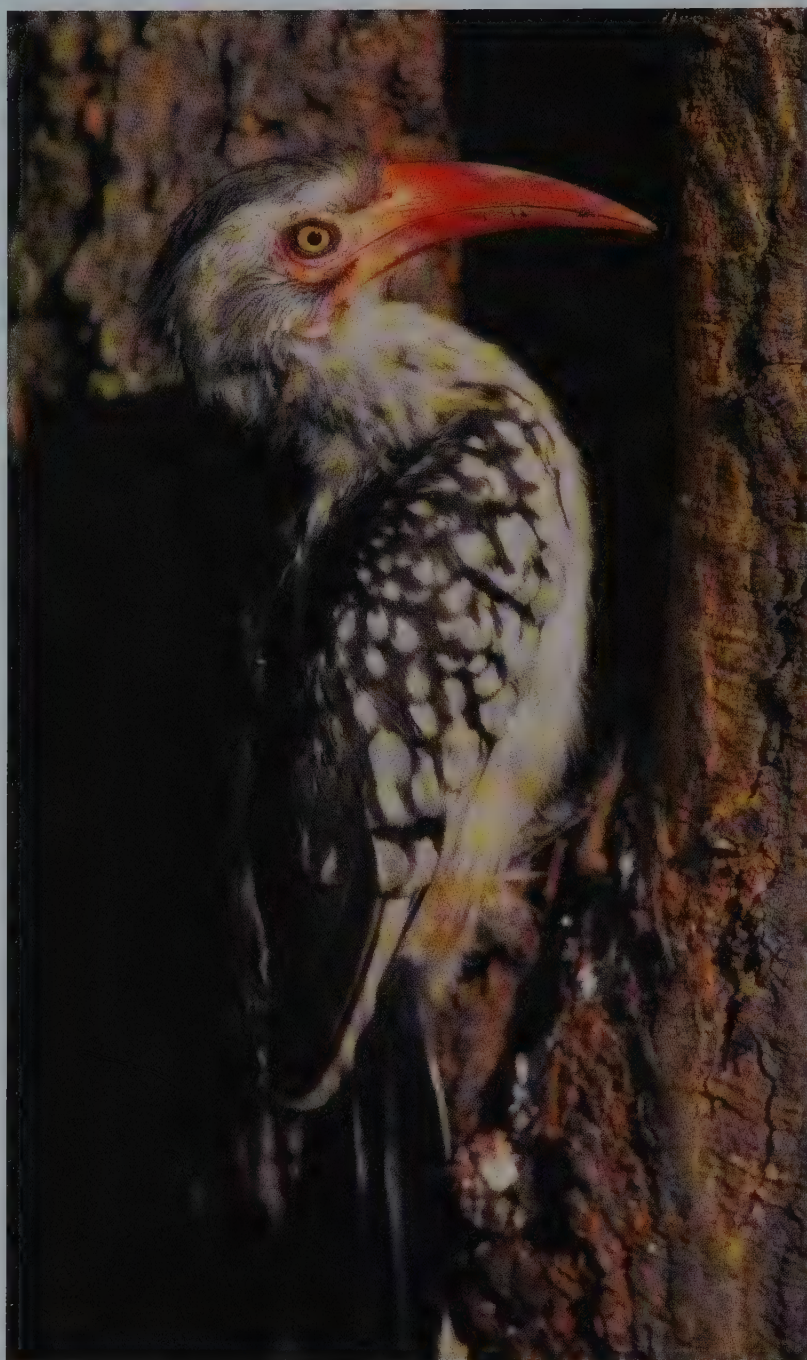


Taxonomy: Considered closest to Monteiro's Hornbill, but also close to Southern Yellow-billed, Eastern Yellow-billed, Von der Decken's and Jackson's Hornbills based on call, ecology and DNA studies. Five subspecies currently recognised, and were treated as full species with vernacular names in Sinclair & Ryan (2010), since the two least different subspecies were studied in detail in their Namibian contact zone and found to act as good species. Apart from these, birds in northern Botswana have formerly been separated as subspecies *ngamiensis*; population in northern Kenya has been considered as a yet un-named subspecies. The five subspecies/possible species are: *T. e. erythrorhynchus* (Northern Red-billed Hornbill) in the northern part of range from Mali and Burkina Faso east to Somalia and south to northern Tanzania; *T. e. damarensisi* (Damara Red-billed Hornbill) northern Namibia and southern Angola; *T. e. rufirostris* (Southern Red-billed Hornbill) in south-east Angola east to northern South Africa; *T. e. ruahae* (Tanzanian Red-billed Hornbill) in Tanzania only; *T. e. kemp*i (Western Red-billed Hornbill) in Senegal, The Gambia, east into northern Guinea and western Mali.

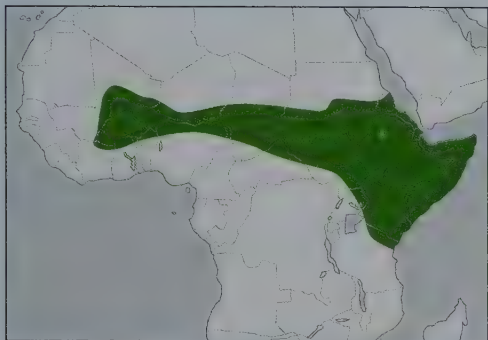
Distribution: Africa; much of the Sub-Saharan continent from the edge of the desert to northern South Africa (absent from the forests across most of West and Central Africa).

Description: 35 cm. Male 124–220 g; female 90–200 g. From other sympatric *Tockus* hornbills by combination of pied plumage with white-spotted wings and red bill; except from Jackson's Hornbill where they overlap by smaller bill and reddish (not black) area around eye. Nominate race is a small slender hornbill with pied plumage and long, slender reddish bill in male that has black inner half of lower mandible. Female is smaller and bill all red. Juvenile of either sex resembles adult male, pale orange bill shorter with black patch at base. Subspecies differ mainly in facial features of cheek plumage, eye and circum-orbital skin colours. The call is a series of high-pitched chucking notes uttered singly, or in a series leading into double notes when more excited *kok-kok-kok ...kokok-kokok*. The calls of at least some of the subspecies differ in quality and tempo, and the head-down bobbing display movements in the extent that the wings are closed or opened, but more detailed analysis is required.

Ecology and habits: Occurs in savanna, open woodlands and grasslands with some trees. In dry areas, such as Namibia and



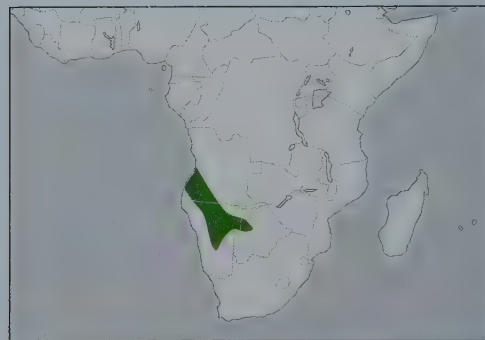
Southern Red-billed Hornbill; female at nest, South Africa. Tim Laman



Distribution for Northern Red-billed Hornbill.



Northern Red-billed Hornbill; female, Kenya. Morten Strange



Distribution for Damara Red-billed Hornbill.



Northern Red-billed Hornbill; female, Kenya. Morten Strange

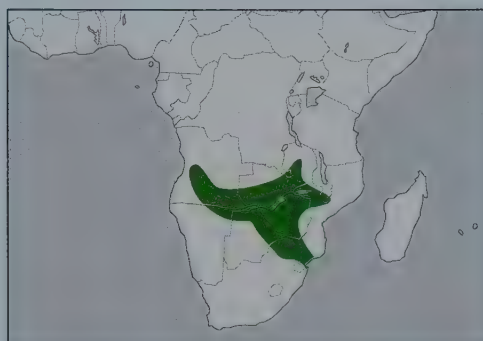


Damara Red-billed Hornbill; male, Namibia. Paul Noakes

RED-BILLED HORNBILL

the Sub-Saharan region, it extends into drier thorn-scrub and stony hills. It occurs from the lowlands to elevated areas, in Ethiopia up to 2,100 m elevation. It perches in trees but takes most of its food (94% according to one survey) on the ground; in the northern part of the range, the nominate subspecies also feeds in the trees, especially in regions where it is the only *Tockus* hornbill. It walks and runs around on the ground and hunts mainly for insects and other invertebrates. It likes to dig through loose dirt and leaf-litter with its long bill; it often visits piles of droppings from the big game to pick up beetles and fly larvae in the dung. Other important food items include termites, ants, grasshoppers as well as butterflies, crickets, centipedes, scorpions and occasionally vertebrate prey such as small lizards, bird nestlings and rodents. It will take a few fruits and seeds, and in some parts of the range, like West and East Africa, vegetable matter is an important part of the diet. It is usually found as resident pairs or small family parties. It is territorial during the breeding season, and the pair normally sticks to their home range, flying out to feed in the surrounding savanna in the early morning and returning to a roosting tree in the evening. During the dry season when not breeding, it becomes somewhat nomadic in most areas and flocks may form, feeding together and gathering at watering holes in the savanna where dung piles and food are plentiful, but often returning to roost on territory. In Zimbabwe, flocks numbering hundreds have been reported, and in a bizarre incident some 1,000 birds drowned while trying to cross Lake Kariba during a migration-like movement.

Breeding ecology: The breeding activity starts towards the beginning of the rainy season, some 4–7 weeks after the start of the main rains. This is usually Mar–Nov in West



Distribution for Southern Red-billed Hornbill.

Africa, Apr–May in Somalia, Feb–Mar in Namibia, Sep–Feb in the southern parts of its range, and various months depending on local conditions in the Equatorial area. The nest is a natural cavity at 0.3–2.1 m up into a tree, often an old woodpecker or barbet hole or an abandoned beehive. This species competes

with other *Tockus* hornbills and other hole-nesting birds in the same area for nesting holes, and has been observed emptying out a nest already containing chicks. It is monogamous and territorial; the female will select the nest and together the pair will prepare the nesting hole, the female going in and out to line it, mainly with leaves as well as bark, flowers, dry grass and snail shells. The female will do most of the work, but the male stays nearby and brings material to her. After mating, the female will enter the nest cavity and seal the opening, using her own droppings and juicy insects as cement; the male occasionally brings some lumps of mud as well. The female lays 2–7 eggs; the first eggs daily, later at an interval of up to 7 days. The incubation period is 24–27 days and the eggs hatch a few days apart as they were laid. During the nesting period, the male feeds



Southern Red-billed Hornbill; immature male with insect, South Africa. Tim Laman

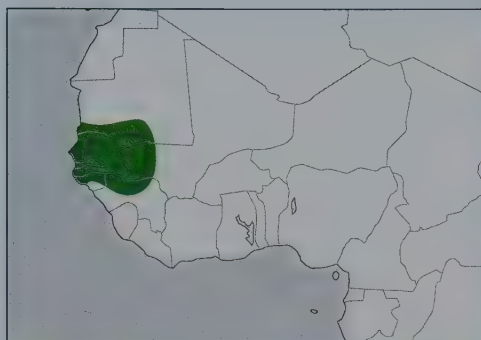
Facing page: Southern Red-billed Hornbill; male, South Africa. Con Foley



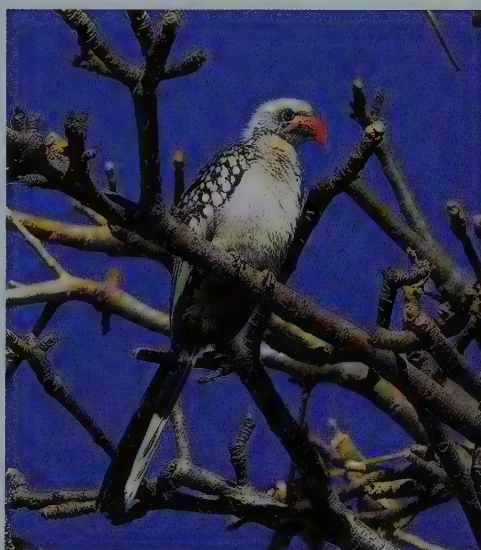
RED-BILLED HORNBILL

the female and later the chicks with single food items carried at the tip of the bill. Feeding rates are highest soon after the female enters, and again later when the chicks start hatching, often around 5-9 feeds per hour. The feeding rates peak when the chicks are half grown and scream loudly for food; one morning feed of 50 visits per hour was recorded in Tsavo NP in Kenya. When the oldest chick is 21-22 days old, the female emerges and helps the male in the feeding. Feeding frequency drops off to 6 feeds per hour, for some nests as low as 2.5. The chicks fledge when 39-50 days old. A survey in South Africa found that only 45% of eggs laid developed into fledged chicks, but this was mainly because many eggs were infertile; of the hatched eggs during a survey in Kenya, 94% developed into fledglings. An average of 1.4-1.5 young is reared per breeding attempt. There are many records of the adult hornbills being preyed upon by the multiple species of hawks and eagles that live on the savanna, occasionally also by snakes; when this happens during breeding, the nestlings in the nest will starve to death.

Status: The range of this species, although somewhat fragmented, is huge, covering almost 11 million km². If subspecies are confirmed as full species, some taxa with small ranges could be of concern, such as *T. e. ruahae* endemic to Tanzania. In general, widespread and locally common throughout the range; readily adapts to cultivated areas and indeed seems to benefit from grazing of open spaces as long as woodlands with large trees suitable for nesting are available nearby. The territory size is about 10 ha with about 2 pairs per km² in South Africa. In Namibia, *T. e. damarensis* nests in man-made nesting boxes. Considering this, the species is not regarded as threatened with global extinction.



Distribution for Western Red-billed Hornbill.



Western Red-billed Hornbill; male, Gambia. Artur Bujanowicz



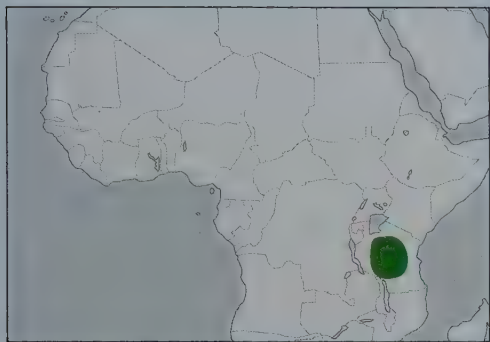
Western Red-billed Hornbill; female, Mali. Thierry Helsens



Western Red-billed Hornbill; female, Mali. Thierry Helsens



Western Red-billed Hornbill; male, Gambia. Artur Bujanowicz



Tanzanian Red-billed Hornbill



Tanzanian Red-billed Hornbill; male. Pete Morris



Tanzanian Red-billed Hornbill; adult pair with male on left. Hugh Chittenden

An un-named subspecies

A population of Red-billed Hornbill in the Baringo District in the Rift Valley Province in Kenya shows some distinct features and could be considered as a yet un-named subspecies.



Top and above: Adult male of form that might, with further study, be proposed as the Baringo Red-billed Hornbill. Philip Stapelberg

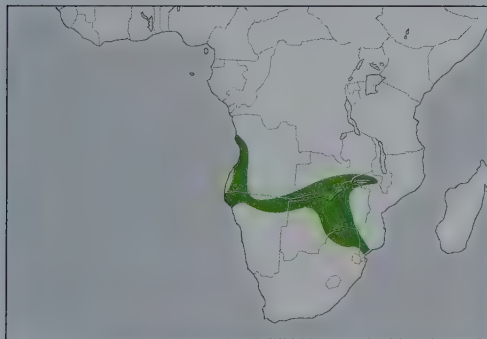
SOUTHERN YELLOW-BILLED HORNBILL

Tockus leucomelas (*Buceros leucomelas* Lichtenstein, 1842)



Taxonomy: Monotypic. In the past considered conspecific with Eastern Yellow-billed Hornbill but differs in voice and soft-part colours. Closely related to Von der Decken's and Jackson's Hornbills, and less so to Monteiro's and Red-billed Hornbills, based on call, ecology and DNA studies. Population in Angola has been suggested separated as subspecies *elegans* on basis of smaller size, paler plumage and differences in soft-part colours, and from eastern part of range as subspecies *parvior* on basis of smaller size; but variations are uncertain and further studies are needed.

Distribution: Southern Africa; from south-west Angola and Namibia across Botswana, Zimbabwe and southern Zambia east to southern Malawi, western Mozambique and northern South Africa.



Southern Yellow-billed Hornbill; male, South Africa. Tim Laman

Description: 40 cm. Male 153–242 g; female 138–211 g. Combination of pied white-spotted plumage, most like Red-billed Hornbill, and yellow bill diagnostic within range. It is a small slender hornbill with pied plumage and long yellow bill. Male has broad bill and low casque ridge extending to tip. Female is smaller with smaller bill and shorter casque. Juvenile is like adult but with shorter dull-yellow bill with brown spots. The call is similar to Red-billed Hornbill's but somewhat deeper, more liquid and the terminal phrases run together rather

than being disyllabic; a series of clucking notes uttered singly, or in a series sometimes leading into a continuous bubbling call *kok-kok-kok ... korkorkorkork*.

Ecology and habits: Occurs in savanna and open woodlands, including along rivers and grasslands with scattered trees; in the west also in more arid semi-desert and thorn-bush country. It feeds on the ground or low in the bushes, by walking and running to catch small prey. It does not dig as much in the

ground as the Red-billed Hornbill does, but instead searches on the ground or in the leaf litter and on branches and picks off animals with its long strong bill. The food is mainly small invertebrates, such as ants and termites, especially during the dry season, but when available also grasshoppers, beetles, caterpillars, centipedes and scorpions. It takes some vertebrate prey such as bird eggs and nestlings, and rodents during years of abundance, as well as some fruits and seeds. It is usually found in resident pairs or small family flocks and it can

stay in the home range all year. It is territorial and sedentary in most areas; the pair normally flies out to feed in the morning and comes back to the same roost in the evening. In some areas with a long dry season, like the Kalahari Desert, it will move out in search of better feeding grounds when not breeding.

Breeding ecology: The breeding activity starts after the first summer rains, in Sep-Mar.

The nest is a natural cavity at 0.8-12.2 m up into a tree. This hornbill competes with other hole-nesting birds for nest cavities, but it appears to accept other *Tockus* hornbills, such as Red-billed and African Grey Hornbills to co-exist and nest nearby, occasionally in the same tree. It is monogamous and territorial; the pair will start bonding about a month before egg-laying starts with courtship displays such as calling, spreading wings, bowing heads

and exchanging food. The pair will start to prepare the nesting hole by sealing external cracks and lining the nest floor with grass and leaves. After mating the female will enter the nest cavity and seal the opening, using mainly her own droppings until only a 5-mm-wide crack remains. After 4-5 days in the nest, the female lays 2-6 eggs at intervals of 1-4 days. The incubation period is 24 days. During her confinement, the female will moult all her



Southern Yellow-billed Hornbill; female, South Africa. Con Foley

SOUTHERN YELLOW-BILLED HORNBILL

flight feathers. During the nesting period, the male feeds the female and later the chicks with single food items. In the beginning, he visits the nest some 3 times per hour, but this rate rises abruptly when the eggs start hatching, and peaks at 11 times per hour when the chicks

are 10–20 days old. The eggs will hatch in the order they were laid, over a period of up to 9 days. The female will pass on food from the male to the chicks until they are about 10 days old and able to reach up and grab food directly from the male. When the chicks are 10–15

days old they can also turn around and squirt their droppings out of the nest like the female does; until that point the female cleans out the nest by removing soiled leaves on the nest floor. When the oldest chick is 19–27 days old, the female will emerge and help the male in the feeding. The juveniles will re-seal the nest unaided from the inside. The chicks fledge after 42–47 days but not all at once, the younger chicks staying in the nest and re-sealing the opening after the older ones leave. The whole nesting cycle lasts 70–76 days. Immediately after leaving the nest, the juveniles are weak fliers, will hang around the nesting tree, and get fed by the parents until they are strong enough to fly out on their own. They learn gradually to forage for themselves, but they will still be taking food from the parents until some six weeks after they leave the nest. A survey in South Africa found that only 38% of eggs laid developed into fledged chicks; while overall, 92% of nesting attempts produced at least one fledgling. In Namibia, a survey over several seasons found that each pair produced 1–5 nestling with a mean of 2.4 young per pair. The adults are preyed upon by as wide variety of hawks, eagles, owls and falcons that are present in this habitat, as well as mongooses.

Status: This species is widespread throughout a large range of almost 2 million km², with a variety of savanna habitats where they are generally common. It can be found in many game reserves and protected areas and it is also adaptable and can exist in partly cultivated areas, as long as suitable nesting sites are available. It readily comes near roads and safari lodges to feed. The territory size is about 17 ha with about 5 pairs per km² in South Africa. Considering this, the species is not regarded as threatened with global extinction.

Facing page: Southern Yellow-billed Hornbill; immature male, Etosha National Park, Namibia. Paul Noakes



Southern Yellow-billed Hornbill; adult pair calling and displaying, with throat inflated, male on left. Tim Laman



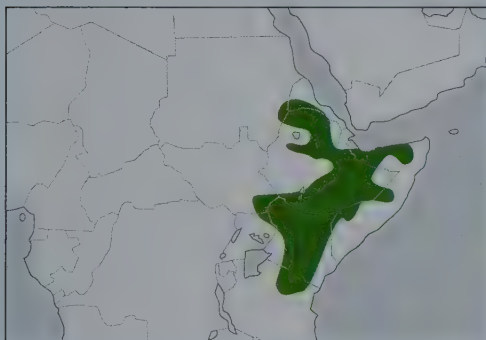
EASTERN YELLOW-BILLED HORNBILL

Tockus flavirostris (*Buceros flavirostris* Rüppell, 1835)



Taxonomy: Monotypic. In the past considered conspecific with Southern Yellow-billed Hornbill but differs in voice and soft-part colours. Closely related to Von der Decken's and Jackson's Hornbills, and less so to Monteiro's and Red-billed Hornbills, based on call, ecology and DNA studies. Population in north-east Somalia has been suggested separated as subspecies *somaliensis* on basis of slightly smaller size and orange markings on bill, but these characteristics seem variable and further studies are needed.

Distribution: Eastern Africa; from Eritrea, eastern Sudan, Djibouti and Somalia south across Ethiopia, South Sudan, north-east Uganda, Kenya to north-east Tanzania.



Description: 40 cm. Male 225–275 g; female 170–191 g. Combination of pied white-spotted plumage, similar to Red-billed and Jackson's Hornbills, but yellow bill diagnostic within range. Small slender hornbill with pied plumage and long yellow bill; differs from the allopatric Southern Yellow-billed Hornbill mainly by black (not reddish) bare skin around eyes, and more extensive bare skin on throat of the male, normally pink but can inflate and brighten when calling during the breeding season. Male has broad bill and low ridge casque extending to tip. Female is smaller, with smaller bill and shorter casque, with black skin



Eastern Yellow-billed Hornbill; male calling. Jacques Erard

around the eyes and on the throat. Juvenile is like adult but with shorter dull yellow bill with brown spots. The call and wing-fanning display is similar to Southern Yellow-billed Hornbill's, but the notes are notably lower-pitched.

Ecology and habits: Appears to have been separated from Southern Yellow-billed Hornbill by a belt of unsuitable habitat of miombo woodland (Swahili for *Brachystegia* trees) which run across southern limit of its range; the two forms then developed into separate species in a typical case of allopatric speciation. This species occurs in open savanna with thorn-bushes, usually below 1,400 m elevation. It feeds on the ground or low in the bushes, walks, runs and picks off prey with its strong bill. It takes many grasshoppers, crickets and termites and digs into dead wood to pick out beetles and larvae. It regularly joins or is joined by groups of Dwarf Mongooses in search of prey; in a mutual relationship, where the mammals benefit from the hornbills performing guard duties, the hornbills from insects flushed from



Eastern Yellow-billed Hornbill; pair, male on left, Ethiopia. Raphael Jordan



Eastern Yellow-billed Hornbill; female with fruit, Kenya. Ron Hoff



Eastern Yellow-billed Hornbill; female flying. Philip Stapelberg

cover, and both have special behaviours to initiate following. It also takes many fruits and seeds. It is usually found in resident pairs or small family flocks and is probably territorial and sedentary throughout most of its range. In Somalia it has been reported to shift out of the arid lowlands into wetter hills outside of the breeding season.

Breeding ecology: The breeding ecology is not well studied. This species has been reported to lay eggs during Feb-Mar in Kenya and later during Mar-May or Oct-Nov further north in Ethiopia and Somalia. The nest is a natural cavity at 1.5–4.5 m up into a tree or a rock face, often in an *Acacia* tree. Monogamous and territorial; the pair will bond by performing head-down, open-winged displays and courtship feeding near the nest. The female enters the nest where she lays 2–3 eggs. The opening is reduced to a slit of some 6–10 cm high and less than 2 cm wide. The male feeds the female and later the chicks with single food items carried in the tip of the bill. However, incubation and nestling periods and other details have not been recorded for this species, although probably similar to its southern sister species.

Status: This species is uncommon and at a fairly low density across a large range of over 1 million km². In Kenya it is uncommon, except around the Samburu Game Reserve where it is locally common. It can be found in many protected areas and can exist in arid regions with little human impact, as long as large trees suitable for nesting are available. The world population has not been estimated, but it appears to be declining slowly, due to loss of suitable nesting trees. However, the species is not yet regarded as threatened with global extinction.

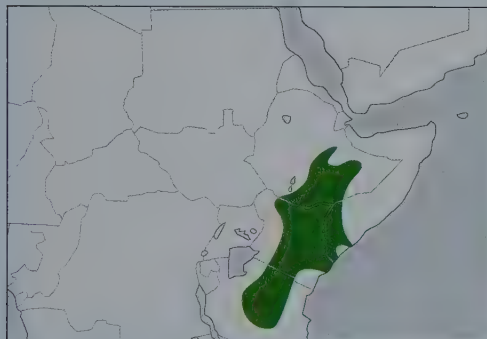
VON DER DECKEN'S HORNBILL

Tockus deckeni (*Buceros deckeni* Cabanis, 1869)



Taxonomy: Monotypic. In the past sometimes considered conspecific with Jackson's Hornbill. Also closely related to Southern Yellow-billed and Eastern Yellow-billed Hornbills, and less so to Monteiro's and Red-billed Hornbills, based on call, ecology and DNA studies.

Distribution: East Africa; from Ethiopia, Somalia south across Kenya to northern Tanzania.



Description: 35 cm. Male 165–212 g; female 120–155 g. Small slender hornbill with boldly pied plumage. Bill and head features are diagnostic; where it meets with Jackson's Hornbill in the east Lake Turkana area, can be recognised by smooth all-black wings; male has broad reddish bill and low ridge casque with anterior half yellow. Female is smaller, with shorter all-black bill and casque. Juvenile has spotted wing coverts, similar to Jackson's Hornbill and smaller dark bill with yellow patches. The call is a series of clucking notes *wuk-wuk-wuk*, and head-down wing-fanning display similar to its closest relatives.

Ecology and habits: Occurs in savanna and open woodlands with thorny trees. It perches in the small savanna trees and descends to the ground to feed. It walks and runs to catch small animal prey, especially many invertebrates such as grasshoppers, crickets, mantids, beetles,



Von der Decken's Hornbill; male, Kenya. Morten Strange

cicadas, ants, termites, larvae, caterpillars and snails. It also takes vertebrate prey, including tree frogs, lizards, young birds and mice. Plant food includes some fallen fruits and seeds; according to one survey 93% of food was taken on the ground, but it can occasionally perch high in the trees to pick fruits and berries. Like the Eastern Yellow-billed Hornbill, and often with it, regularly follows groups of Dwarf Mongooses in search of prey stirred up by the mammals, which in turn benefit from the hornbill's alarm calls when danger approaches. It is usually found in resident pairs or small family flocks, and it stays in the home range all year. It is territorial and sedentary and will only



Von der Decken's Hornbill; adult pair, male on left, Kenya. Morten Strange



Von der Decken's Hornbill; male, Ethiopia. Adriaan Dijkse



Von der Decken's Hornbill; female, Kenya. Morten Strange



Von der Decken's Hornbill; immature male. Philip Stapelberg

undertake occasional local moves during dry spells outside of the breeding season.

Breeding ecology: The breeding activity starts in Feb-Jul in the northern part of the range, and after the rains in Nov-Mar further south. The nest is a natural cavity at 0.5-5 m up into a tree; often in an old woodpecker hole, less often in a rock face. It is monogamous and territorial; the pair will start bonding with courtship displays such as calling, spreading wings and bowing heads. After mating, the female enters the nest cavity lined with bark flakes and seals the opening, using mainly her own droppings and food remains. She lays 2-4 eggs at intervals of 2-4 days. The pre-laying plus incubation period is about 33 days. The male feeds the female and later the chicks with single food items. When the chicks are 21-28 days old, the female emerges and helps the male with the feeding. The chicks re-seal the nest opening and fledge later after 47-50 days; the whole nesting cycle takes about 80-82 days.

Status: This species is widespread and generally common over a large range of over 1 million km². Locally abundant; during a survey along the Omo River in Ethiopia one pair was recorded every 100 m of a line transect. It can be found in many protected areas and national parks, and it can inhabit fairly arid regions with little human impact. It only seems to be declining in areas where large trees suitable for nesting are being cut down. The world population has not been estimated, but it appears to be substantial and stable, and the species is not yet regarded as threatened with global extinction.

JACKSON'S HORNBILL

Tockus jacksoni (Ogilvie-Grant, 1891)



Taxonomy: Monotypic. In the past considered conspecific with Von der Deckens's Hornbill. Is also closely related to Southern Yellow-billed and Eastern Yellow-billed Hornbills, and less so to Monteiro's and Red-billed Hornbills, based on call, ecology and DNA studies.

Distribution: East Africa; straddled across the border region of three countries: Southern part of South Sudan, north-east Uganda, southern Ethiopia and north-west Kenya.



Description: 35 cm. Body mass and other data generally confused with those of similar-sized Von der Decken's Hornbill. Small slender hornbill with pied white-spotted plumage. Where they overlap in the east of Lake Turkana area, this species can be distinguished from Von der Decken's Hornbill by thick white spots on wings of both sexes; male has broad reddish bill but less yellow in tip than that of its relative and low casque ridge. Female is smaller, with shorter all-black bill and casque. The call is a monotonous series of clucking notes, *wuk-wuk-wuk*, higher pitched and somewhat slower than those of Von der Decken's Hornbill, but head-down wing-fanning display similar to its closest relatives.

Ecology and habits: Occurs in open savanna with bushes and thorny trees. It perches low and drops down onto the ground to



Jackson's Hornbill; females, Kenya. Shailesh Patel

feed on small animals. No detailed studies of habits and ecology are available, but they must be presumed to be similar to the widely distributed and better-studied allospecies Von der Decken's Hornbill. It is territorial and sedentary within its home range.

Breeding ecology: The breeding activity starts after the rains towards the end of the year, Nov-Mar. The displays around the nesting site appear similar to those of Von der Decken's Hornbill but there are few studies available specifically for this species.

Status: This species is local with a small distribution range; it depends on large trees with natural cavities suitable for nesting. However, it is considered locally common within its small range. The world population has not been estimated; although thought to be decreasing, the species is not regarded as threatened with global extinction.



Jackson's Hornbill; females, Kenya. Philip Stapelberg



Jackson's Hornbill; male, Kenya Ron Hoff

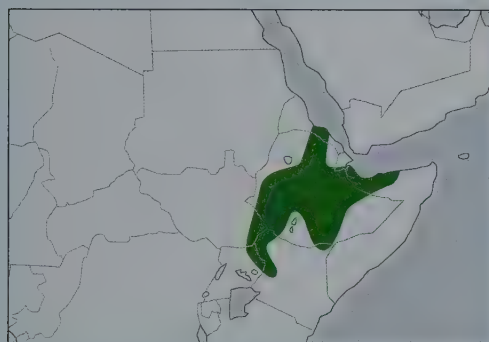
HEMPRICH'S HORNBILL

Tockus hemprichii (*Buceros hemprichii* Ehrenberg, 1833)



Taxonomy: Monotypic. Most closely related to African Pied Hornbill, Crowned Hornbill and Bradfield's Hornbill; those three form a superspecies and all four replace each other geographically and have similar calls and displays. In the past, the population in northern Kenya has been suggested as the subspecies *exsul*.

Distribution: East Africa; from Eritrea, Djibouti, Somalia, across Ethiopia south to east South Sudan, north-east Uganda and northern Kenya.



Description: 50–58 cm. One female 297 g. Small to medium-sized hornbill with grey or grey-brown upperparts and white belly. Differs from Crowned Hornbill, where they overlap, by pale edges on wing coverts. Male has large red bill and low narrow casque ridge with throat skin patches black. Female is slightly smaller, lower mandible of bill has black base; also look for pale green throat skin. Juvenile is similar to adult female, except for sooty-brown bill and black specks at base of white tail feathers. The call is a high-pitched whistling, in single notes or series, also a two-syllabic piping note. During display it bobs up and down with the bill raised, the wings barely opening, like its relatives, uttering a long series of accelerating piping notes *pi-pi-pi-pioh-pioh-pioh*, but at the end calling accelerates and it jerks its tail up and fans it over the back.



Hemprich's Hornbill; male, Ethiopia. Raphael Jordan

Ecology and habits: Occurs in semi-arid areas and wooded habitat with sycamore trees, especially along rivers, cliff bases and hilly gorges. In the Ethiopian Highlands it can be found up to 4,300 m elevation. Here it feeds mainly on insects, including grasshoppers, beetles and caterpillars, but it also catches vertebrates such as skinks and chameleons. Feeds mainly in the trees where it also takes some berries and fruits such as figs; but it may drop down and search the ground and rock crevices for termites and other prey as well. It has been observed catching carpenter bees in the air and carefully removing the sting before swallowing. It is usually found as resident pairs or small family flocks; it is territorial and sedentary in the main part of the range. In Somalia and Kenya it has been reported to move out of its territory outside of the breeding season, and it also moves down into the flatlands in response to local rains. Flocks of up to 14 birds have been reported; during these nomadic movements it might enter the range of Crowned Hornbill.



Hemprich's Hornbill; female, Ethiopia. Piotr Jocyk



Hemprich's Hornbill; male, Djibouti. Werner Suter



Hemprich's Hornbill; female, Ethiopia. Ron Hoff

Breeding ecology: The breeding is not well-studied but starts mainly in Mar-May, also Aug-Oct and Jan in Ethiopia. The nest is most often a natural cavity in a rock face in a gorge, but it can also use a building and sometimes a hole in a tree. The nest is lined with bark and wood flakes. It is monogamous and territorial; the pair will bond by calling and performing their unique tail-fanning display. The female seals herself into the nest and lays 3 eggs. One hole in a rock face was sealed to a slit of 7x2 cm; in another it was 14.5x2.5 cm. The male feeds the female through the crack with single food items carried to the nest in the tip of its bill. Other details such as incubation and nestling periods have not been recorded.

Status: The species is widespread over a large range of some 750,000 km². Its stronghold is Ethiopia where it is reported as widespread and common. It is local and uncommon in other countries, but it does occur in protected areas such as Day Forest NP in Djibouti. Much of its range is remote and inhospitable terrain with little human impact. The world population has not been estimated, but it appears to be substantial and stable, and the species is not regarded as threatened with global extinction.

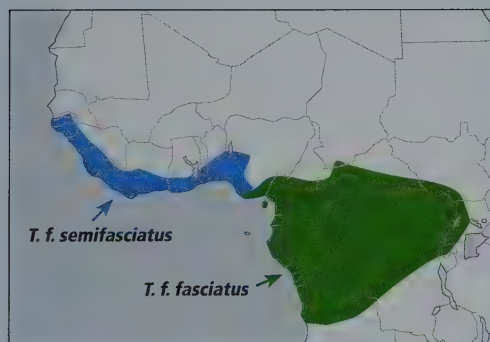
AFRICAN PIED HORNBILL

Tockus fasciatus (*Buceros fasciatus* Shaw 1811)



Taxonomy: Forms a superspecies with Crowned Hornbill and Bradfield's Hornbill, also closely related to Hemprich's Hornbill. These four replace each other geographically and have similar calls and displays. There are two subspecies: *T.f. fasciatus* occurs in central part of range from south-east Nigeria and southern Chad east to Central African Republic, South Sudan, Uganda, Rwanda and south across Cameroon, Equatorial Guinea, Gabon, Congo to northern Angola and south-central Democratic Republic of the Congo. *T.f. semifasciatus* occurs in the west from Senegal, The Gambia and Guinea-Bissau across Guinea, Sierra Leone, Liberia, Cote d'Ivoire, Ghana, Togo and Benin to south-west Nigeria. Initial genetic studies suggest they may be different species, with distinct tail patterns and bill colourations.

Distribution: West and Central Africa.



Description: 50 cm. Male 250-316 g. Female 191-260 g. Fairly small hornbill with glossy-black plumage and white belly. Nominate race male has all-white outer tail feathers and yellow bill and casque ridge with reddish tip. Bare skin around eye and on throat is dark blue. Female is smaller, with smaller bill and casque that has black markings at tip; throat patch is orange. Subspecies *T.f. semifasciatus* has only outer tip of tail white; tip of bill and



African Pied Hornbill; nominate race, female, Cameroon.
Gabi Bujanowicz

casque is black. Juvenile has small pale-yellow almost casqueless bill. The call is some shrill high-pitched whistling notes. A series of 3-4 notes together rising and falling in pitch pi-pi-pi pi-pi-pi pi-pi-pieeu is used in territorial display, calling with the wings closed and bill jerked skywards at each note.

Ecology and habits: Occurs in a variety of wooded habitats from primary rainforest and adjacent secondary forest to deciduous woodlands, palm oil plantations and cultivated areas with some remnant tree cover. Mainly occurs in the lowlands below 900-1,000 m elevation. It is omnivorous and feeds on fruits as well as small animals in about even proportions. Eats an assortment of fruits, 14 different plant genera have been identified, also



African Pied Hornbill; *T. f. semifasciatus*, male, Nigeria.
John Sawyer

many indigenous and cultivated oil palm fruits. The animal prey is mainly invertebrates such as grasshoppers, cicadas, mantids, butterflies, caterpillars and many flying termites, also some spiders, ants and wasps. Occasionally also eats vertebrate animals such as lizards, tree-frogs, rodents, bats and bird nestlings; sunbird and woodpecker nests have been seen robbed, and the hornbill is in turn often mobbed by small birds. It feeds high in large trees, sometimes 30-50 m off the ground, often feeds on the outside of the canopy or flying out to hawk for flying insects. Occasionally comes down to the ground to pick up fallen fruits or prey. It is sedentary and probably territorial throughout much of the huge range, usually seen in pairs or small family groups of 3-5 birds, but more birds may congregate in good fruiting trees.



African Pied Hornbill; nominate race, male, Uganda. Nik Borrow



African Pied Hornbill, nominate race, female, Cameroon.
Artur Bujanowicz



African Pied Hornbill, nominate race, female, Cameroon.
Ron Hoff

AFRICAN PIED HORNBILL

It often roosts communally, and outside of the breeding season regular flocks of 10–20 birds together is not unusual, one old record reported 70 birds from Liberia. In marginal areas and dryer parts of the range, these flocks probably become somewhat nomadic and roam widely in search of food.

Breeding ecology: The breeding starts mainly in the dryer months, Aug in Senegal, Sep–Apr in Liberia, and Nov–Apr in the rest of West Africa. In Central Africa there are records during Sep–Feb from Gabon, Mar–Apr and Sep in Uganda and Jul–Sep in the Congo River region. The nest is a natural cavity at 9–38 m up in a large forest tree; highest in primary forest, lower in secondary growth. The female seals herself into the nest using her own droppings and lays up to 4 eggs. The male feeds the female in the nest with some 6–12 items per hour, mainly animal

prey. During the confinement, the female will moult her flight feathers. She emerges from the nest sometime before the chicks are ready to fledge and helps the male with the feeding. However, incubation and nestling periods have not been recorded. An individual in captivity survived at least 22 years.

Status: This species is widespread over a huge range of over 5 million km². Furthermore, it is an adaptable hornbill that can adjust to disturbed secondary forest and even cultivated areas. Although it has lost some habitat in its range, it has adapted well, and it is common in many areas, reported as very common in Liberia. The world population has not been estimated, but it appears to be large and stable, and the species is not regarded as threatened with global extinction. If separated into two species, the West African race may be of concern.



African Pied Hornbill; *T. f. semifasciatus*, adult male, Nigeria. John Sawyer



African Pied Hornbill; *T. f. semifasciatus*, female, Gambia. Artur Bujanowicz



African Pied Hornbill; *T. f. semifasciatus* female calling, Sierra Leone. Jon Hornbuckle



African Pied Hornbill; *T. f. semifasciatus*, female, Ghana. Nik Borrow



African Pied Hornbill; *T. f. semifasciatus*, adult male with somewhat damaged casque base, Guinea. Nik Borrow

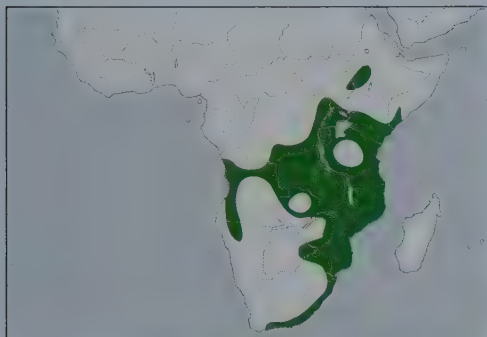
CROWNED HORNBILL

Tockus alboterminatus (*Lophoceros alboterminatus* Büttikofer 1889)



Taxonomy: Monotypic. Forms a superspecies with African Pied Hornbill and Bradfield's Hornbill, also closely related to Hemprich's Hornbill. These four replace each other geographically and have similar calls and displays. Various subspecies have been proposed on the basis of size and darkness of plumage but populations integrate widely.

Distribution: Eastern and southern Africa; from southern Ethiopia and Somalia across all of East Africa south to South Africa; also west to the Democratic Republic of the Congo and Angola.



Description: 50 cm. Male 191–332 g; female 180–249 g. Fairly small hornbill, male plumage is sooty-brown with streaky white superciliary, white belly, thighs and tail tip; bill and ridged casque are bright orange-red with creamy line at the base; eye deep yellow to orange and throat skin patches black. Female is smaller with lower casque, paler yellow eye and throat patch green. Differs from the closely related Bradfield's Hornbill by much darker plumage, but there is virtually no overlap in range. Juvenile has yellow almost casqueless bill and white spots on wing coverts. The call is a variety of loud high-pitched whistling notes. A series of notes together, rising and falling in pitch, is used in territorial display, uttered with the wings closed and the bill flicked skywards.



Crowned Hornbill; immature male. Hugh Chittenden



Crowned Hornbill; female. Tim Laman



Crowned Hornbill; adult female, notice pale lower jaw and throat bare skin patch, Angola. Jon Hornbuckle

Ecology and habits: Occurs in a variety of wooded habitats; often coastal and riverine forests or deciduous woodlands in montane terrain up to 3,000 m elevation. It can feed in adjacent cultivation and even enters gardens in built-up settlements to feed on cultivated plants. It is omnivorous and feeds on a combination of fruits and small animal prey. Eats an assortment of fruits, especially during the dry season when animals are harder to come by, with 20 different types identified, including figs and cycad seeds. It also takes cultivated fruit varieties where available, such as oil-palm fruits, peanuts, bananas and maize. The animal prey is mainly invertebrates, such as locusts, cicadas, mantids, butterflies, moths, caterpillars as well as ants, termites and snails. Also takes centipedes, spiders and maggots and pupae from carcasses. Occasionally eats vertebrate animals such as lizards and eggs and chicks of other birds. Arboreal, it feeds mainly inside the trees, actively pursuing prey and flying out to hawk for flying insects, but may also come down to the ground to pick up fallen fruits or hop about in pursuit of prey. It is territorial and mainly sedentary, usually seen in pairs or small family groups of up to 7 birds, especially in moist evergreen forest habitat. In more arid regions, however, it does form flocks and will become somewhat nomadic outside of the breeding season; flocks of up to 80 birds have been reported moving out to different elevations and better feeding grounds.

Breeding ecology: Female lays eggs at the start of the rainy season, that is Oct-Jan in central and southern Africa; it is less seasonal in East Africa which often has two rainy seasons, here it has been observed breeding Feb-Jul and Sep-Nov. The nest is a natural cavity at 1.2–12 m up in a tree; either in the trunk or in a large branch. The cavity is usually only about 20 cm in diameter, the original nest

entrance can be as large as 40 x 9 cm or as small as 7 x 5 cm, but is reduced to a small slit once the female enters. The same nesting site can be used by the resident pair year after year. The pair will bond by visiting the nesting tree and call loudly with bills raised to the sky. The male will repair external cracks in the nesting hole and will courtship feed the female. After mating, the female enters the nest and seals it from the inside, mainly using her own droppings. Throughout the nesting cycle the male will bring not only some lining material for the nest, mainly bark chips, but also some flowers and snail shells, the latter possibly for the female to feed on to increase calcium levels

for egg formation. After 7-14 days in the nest the female lays 2-5 eggs, the first ones with 2 days intervals, the last one after another 4 days. The mean clutch size during a survey in South Africa was 3.6 eggs. Incubation starts when the first egg is laid and lasts 25-27 days. The male feeds the female and later the chicks at the nest with single food items, making 40-80 visits per day. When the oldest chick is 25-30 days old, the female leaves the nest. She then helps the male feed the chicks, who seal the nest after her leaving and stay put for another 15 days. The nestling period is 46-55 days and the total nesting cycle is about 83 days. In South Africa, the mean number of chicks fledged per nest



Crowned Hornbill; maybe female, Pemba Island, Tanzania. Ron Hoff



Crowned Hornbill; immature, Zimbabwe.
Marie-France Granouillet

was 2.5. The young fly well when they leave the nest and do not return to the nesting hole. However, they depend on the parents for food up to a month after fledging. The family will stay together in the home range for about 6-8 months, i.e. until next breeding season.

Status: This species is widespread over a somewhat fragmented but huge range of about 3 million km². Common in many areas; densities vary and have been reported from 14 pairs per km² to 0.2 pairs per km², usually 2-10 pairs per km² in suitable wooded habitat with sufficient tree cover. It occurs in numerous protected areas such as Shimba Hills NP in Kenya, Lake Manyara NP in Tanzania, South Luangwa NP in Zambia and Lengwe NP in Malawi. Outside of protected areas, it has lost some habitat due to developments, and numbers seem to be slowly declining. However, this species is mobile and readily accepts disturbed habitats, and it even enters rural gardens to feed. The world population has not been estimated, but it appears to be large and declining only slowly; in view of this, the species is not regarded as threatened with global extinction.

BRADFIELD'S HORNBILL

Tockus bradfieldi (*Rhynchaceros bradfieldi* Roberts, 1930)



Taxonomy: Monotypic, the last hornbill species to be discovered. Forms a superspecies with Crowned Hornbill and African Pied Hornbill, also closely related to Hemprich's Hornbill. These four replace each other geographically and have similar calls and displays. In the past, population in northern Botswana and western Zimbabwe has been treated as subspecies *williaminae*.

Distribution: Confined to southern Africa; southern Angola and northern Namibia east into southern Zambia, northern Botswana and western Zimbabwe.



Description: 50 cm. 180–395 g. Fairly small hornbill, plumage is light brown with pale superciliary, belly and tail tip; bill and casque ridge is pale orange with yellow line at the base. Differs from the closely related Crowned Hornbill by much paler plumage and bill, but there is no overlap in breeding range. Female is smaller in size with smaller bill and casque and paler superciliary. Juvenile has even smaller paler bill. The call is a loud high-pitched whistling note, uttered singly or rapidly repeated *chleeeo*, the territorial display with wings closed and bill jerked skywards.

Ecology and habits: The core habitat for this species is a special environment typical for this part of Africa, with woodlands on sandy



Bradfield's Hornbill; immature male, Botswana. John Sawyer



Bradfield's Hornbill; juvenile, notice the mottled underparts, Zimbabwe. Marie-France Granouillet

alkaline or alluvial soil dominated by *Baikiaea* and *Pterocarpus* plants with nearby taller stands of the mopane tree (*Colophospermum mopane*) endemic to Africa; the elevation is from 200–1,150 m. From here, the hornbill often moves out into adjacent areas of grassy savanna and riverine woodlands. It feeds mainly on invertebrate prey such as locusts, mantids, beetles, ants, and termites, and larvae that it finds in animal dung piles. Occasionally takes vertebrate prey such as lizards and frogs as well as many fruits and seeds. Arboreal, it feeds mainly in the trees, but it also drops down to the ground – more frequently so than its close relative, the Crowned Hornbill – especially during the dry season. It also hawks for flying insects. It is territorial and sedentary, usually seen in pairs or small family groups. Towards the end of the dry season, when food is scarce,

it becomes somewhat nomadic and forms flocks; 70 birds together have been reported, wandering locally in search of food.

Breeding ecology: Female lays eggs at the start of the rainy season, in Sep-Dec; in case of a second attempt this could be in Mar. The nest is a natural cavity in a tree or a rock face; one nest was 7 m off the ground. One hole in a cliff was 40 cm deep; the nest always has an escape chimney above. The male brings

bark lining for the nest, and the female seals the gap from the inside using her droppings and food remains. After 10 days in the nest, the female lays 3 eggs. Incubation period is uncertain but young hatch about 38 days after female seals the nest. The male feeds the female and later the chicks at the nest with single food items, and he visits the nest every 1-2.5 hours and can fly up to 2 km from the nest to find food. When the oldest chick is about 32 days old, the female leaves the nest.



Bradfield's Hornbill; female. Hugh Chittenden



Bradfield's Hornbill; male, Botswana. Hugh Chittenden

She then helps the male feed the chicks. The nestling period is at least 48 days.

Status: This species has a fairly small range for an African hornbill, of just over 300,000 km²; within this range, the occurrence is somewhat patchy and it is only locally common. It is affected by habitat loss due to conversion by man and damage by elephants; in Zimbabwe the species has lost some 40% of its habitat range. It occurs in protected areas such as Chobe NP in Botswana, Waterberg NP in Namibia and Hwange NP in Zimbabwe. This species is mobile, and outside of the breeding season it is able to use a wide range of habitats. The world population has not been estimated, but it appears to be substantial and declining only slowly; in view of this, the species is not yet regarded as threatened with global extinction.

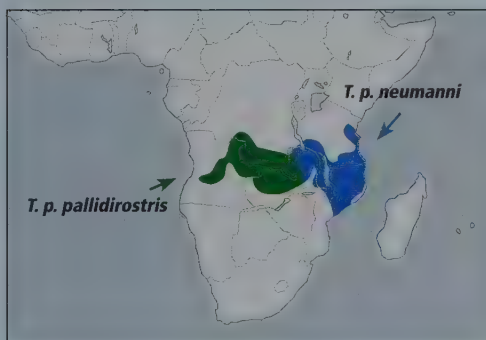
PALE-BILLED HORNBILL

Tockus pallidirostris (*Buceros pallidirostris* Hartlaub and Finsch, 1870)



Taxonomy: Forms a superspecies with African Grey Hornbill. Where the two subspecies overlap in Zambia, they may occasionally hybridise. Two subspecies recognised: *T. p. pallidirostris* occurs in parts of Angola, Democratic Republic of the Congo, and in Zambia east to the Luangwa Valley. *T. p. neumanni* occurs from Luangwa Valley in Zambia east into Tanzania, Malawi and northern Mozambique; vagrant in southern Kenya around the Taveta district only.

Distribution: South-central and East Africa.



Description: 43-50 cm. Male 248-325 g; female 170-217 g. Medium-sized hornbill with grey plumage and white-streaked wing coverts, and white belly, superciliary and tail tip. It differs from the partly sympatric African Grey Hornbill in both sexes by its pale all-creamy bill and prominent ridged casque, without dark areas. Female smaller than male and has lower ridge on casque. Subspecies *T. p. neumanni* is smaller and has paler face and reddish tip to bill. Juvenile is like adult, but almost casqueless bill is smaller. The call is a series of drawn-out piping notes, similar to the call of African Grey Hornbill, but somewhat lower pitched and more mellow, and accompanied by the same wing-flipping display.



Pale-billed Hornbill; nominate race, male, Kolwezi, Democratic Republic of the Congo. Neil Gray

Ecology and habits: Occurs in wooded habitat, especially tall and dense clusters of miombo (*Bracystegia*) woodland typical for this part of Africa. Where it overlaps with African Grey Hornbill, this species prefers denser, taller deciduous woodland and forest. It is recorded up to 1,372 m elevation. It is arboreal and feeds mainly in the trees on animal prey, presumably mainly insects. It also takes some plant matter such as seeds and gum from damaged pods, but there are

few details available and no recent studies performed. In the dry season it descends to the ground more frequently to feed, and it has been observed dust-bathing. Usually a pair or a small family party of 5-8 birds moves around together. It is presumably sedentary, although it might move about locally during the dry season, when the deciduous woodlands lose their leaf cover.

Facing page: Pale-billed Hornbill; *T. p. neumanni*, immature female, Tanzania. Nik Borrow



PALE-BILLED HORNBILL

Breeding ecology: The breeding activity starts at the end of the dry season in Aug–Nov, as or just before the trees come into leaf. The nest is a natural cavity in a tree; the female enters the nest and the opening is sealed to a narrow slit. The female lays 4–5 eggs and is fed at the nest by the male. She will moult her flight and tail feathers while confined inside the nest. Further details, such as the incubation and nestling periods, have not been recorded for this species.

Status: This species occurs over a large range covering some 1.3 million km²; it is widespread throughout much of the area, but generally uncommon; considered frequent but uncommon in Tanzania. Found in some protected reserves such as the Luangwa Valley in Zambia and Mikumi NP in Tanzania. It requires more forested habitat than the similar African Grey Hornbill, so in countries like Zambia, Malawi and Mozambique where human expansion reduces natural miombo tree cover, the Pale-billed Hornbill might be declining as the more adaptable African Grey Hornbill expands. The world population has not been estimated, but it is presumed to be large and declining only slowly in some areas; considering this, the species is not yet regarded as threatened with global extinction.



Pale-billed Hornbill; *T. p. neumanni*, male, Zambia. John Sawyer



Pale-billed Hornbill; *T. p. neumanni*, male, Tanzania. Werner Suter



Pale-billed Hornbill; nominate race, male, Democratic Republic of the Congo. Nigel Voaden



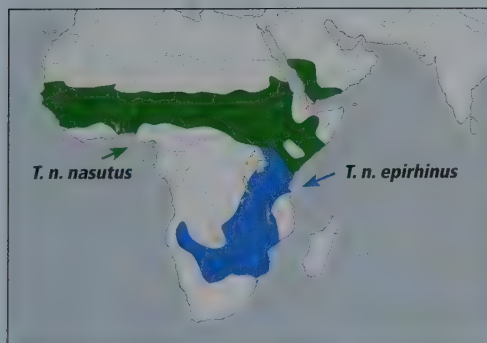
Pale-billed Hornbill; nominate race, adult female left and juvenile, Democratic Republic of the Congo. Nigel Voaden

AFRICAN GREY HORNBILL

Tockus nasutus (*Buceros nasutus* Linnaeus, 1766)

Taxonomy: Forms a superspecies with Pale-billed Hornbill. Larger, darker population in north-east Ethiopia and the Arabian Peninsula suggested as subspecies *forskalii*; paler birds from southern Angola and Namibia suggested as subspecies *dorsalis*; neither appear sufficiently distinct to merit subspecies treatment. Two subspecies currently recognised: *T. n. nasutus* occurs in the north from Mauritania east across West Africa to Eritrea and Ethiopia; this is the only hornbill to cross the Red Sea and occur in parts of Saudi Arabia and Yemen on the Arabian Peninsula; from there it extends south to northern Uganda and northern Kenya. *T. n. epirhinus* occurs from southern Uganda and southern Kenya across East Africa west to southern Angola and central Namibia and south to northern South Africa. An initial genetic study suggests these two populations may be separate species, as intimated by different male casque structure.

Distribution: Africa; much of the Sub-Saharan continent, from south of the Sahara desert to northern South Africa in open savanna habitats, hence absent from the forested regions of Central Africa; it extends onto the Arabian Peninsula and is recorded as a vagrant in Egypt.



Description: 45–51 cm. Male 172–258 g; female 163–215 g. From the partly sympatric



African Grey Hornbill; nominate race, male, Mali.
Thierry Helsens

Pale-billed Hornbill, in both sexes, by darker bill and smaller casque; in flight also by pale back. Grey upperparts and darker flight feathers, with prominent white superciliary running down to hind neck, underparts and tail tip. Nominate race male has black casque ridge and black bill with pale grey patch at base of upper mandible and dark grey bare throat patches. Subspecies *T. n. epirhinus* has more cylindrical casque with pointed tip and yellowish patch on upper mandible of bill. Female is smaller, with all-creamy casque and upper mandible of bill and reddish bill tip, with pale green throat patches. Nominate race female has longer bill and less obvious white bars across black base of lower mandible than shorter-billed southern populations of



African Grey Hornbill; *T. n. epirhinus*, nominate race, male, The Gambia. Piotr Jonczyk



African Grey Hornbill; nominate race, male, Mali.
Thierry Helsens

subspecies *T. n. epirhinus*. Juvenile is like adult male, but almost casqueless bill is smaller. The call is a plaintive whistling or piping note, uttered singly or in a series; during display the bill is raised to the sky and wings flicked open on each note, *pi pi pi pipipiew*.

Ecology and habits: Occurs in a variety of wooded habitat from open savanna and deciduous woodlands to edges of dense forest. At margins of distribution, extends into grasslands and semi-deserts. It is arboreal and lives and feeds mainly in trees and bushes, flying from tree to tree with buoyant undulating flight. During a survey in South

Facing page: African Grey Hornbill; nominate race, male, Ethiopia. Adriaan Dijkse





AFRICAN GREY HORNBILL

Africa, 70-80% of food was found in the foliage of trees and bushes; it will drop down to the ground to catch prey and (more rarely) to dig through animal dung piles and carcasses for maggots, or to dust-bathe. The food is mainly animal prey such as grasshoppers, beetles, mantids and other insects as well as their larvae or caterpillars. Catches large bees in flight and removes the sting before swallowing. It also takes vertebrate prey such as lizards and nestling birds, as well as plant food like figs and other fruits, acacia seeds and peanuts, especially during the dry season. It is territorial and largely sedentary through much of its range, usually found as resident pairs or small family parties. Outside of the breeding season it normally roams widely in search of food, but habits vary across the enormous range and in northern Sub-Saharan areas flocks of 50-100 birds may gather and move north in May-Jun and south again in Oct-Nov in search of greener areas. In less deciduous parts of eastern and southern Africa movements are more erratic and local.

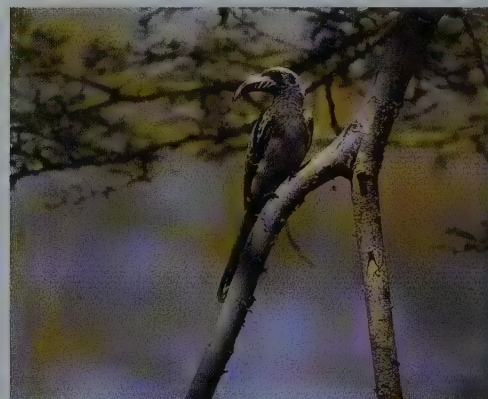
Breeding ecology: The breeding activity coincides with the start of the wet season when trees and bushes come into leaf. This is usually during Aug-Mar in Central and southern Africa; in eastern and northern parts of range, variations are more local, and breeding can occur in most months of the year. The nest is a natural cavity 0.7-9 m up into a tree, the mean nest height is 4 m; in more arid regions a rock face cavity or an old barbet hole in an embankment may also be used. The nest cavity is small with mean diameter just 23 cm and the floor typically 8 cm below entrance. The same hole can be used for several consecutive years. This hornbill is monogamous and territorial; the male and the female will inspect the site early in the season and call and display nearby. The female will inspect the nest and start to



African Grey Hornbill; nominate race, female, Nigeria.
John Sawyer

seal it; after mating she will enter and seal the entrance till only a narrow slit is left, using her own droppings and food pulp, as well as millipedes brought in by the male who will also bring bark chips and dry leaves to line the nest floor. After 5-11 days in the nest, the female lays 2-5 eggs; each takes 1-2 days interval. The incubation period is 24-26 days, the eggs hatching at about the intervals they were laid. During the nesting period, the male will feed the female and later the chick with single food items carried to the nest at the tip of the bill. The chick is naked and weighs 12-14 g at hatching. By the time it is 5 days old, the eyes will open up and feather-quills will emerge; after 30 days it is well feathered. When the oldest chick is 19-34 days old, the female will break out of the nest, feed herself and help the male feed the chicks. The chicks will re-seal the nesting hole themselves and fledge when 43-49 days old, the oldest one leaving first and the younger a few days later. A survey in South Africa found that 56% of eggs laid produced fledged chicks; 91% of nesting attempts produced at least one fledgling. An average of 2.4 young was reared per breeding attempt. The main cause for nesting failure was tree bark growing to constrict the nest entrance, closing it before female and chicks could emerge.

Status: The range of this species is huge; apart from that, it is a mobile and adaptable species that can adjust to most wooded habitats and even cultivated areas. An urban species in various parts of South Africa, nesting can be in artificial logs or holes excavated by barbets. The territory size for a pair in South Africa was found to be 22-63 ha, which is somewhat larger than for smaller, ground-feeding congeners. The world population has not been estimated, but it is presumed to be large and stable; considering this, the species is not regarded as threatened with global extinction, even if separated as two distinctive populations.



African Grey Hornbill; *T. n. epirhinus*, nominate race, female, Kenya. Morten Strange



African Grey Hornbill; *T. n. epirhinus*, male, South Africa.
Tim Laman



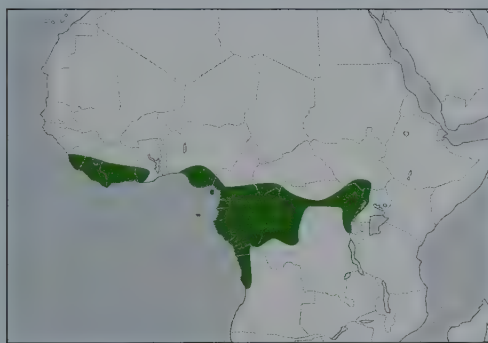
African Grey Hornbill; *T. n. ephrinus*, female, South Africa. Con Foley

RED-BILLED DWARF-HORNBILL

Tockus camurus (Cassin, 1857)

Taxonomy: Monotypic. Previously, population from Nigeria westwards treated as subspecies *T. c. pulchrirostris*.

Distribution: West and Central Africa from Sierra Leone east across Liberia, Cote d'Ivoire, Ghana, Nigeria, Cameroon and Central African Republic to Democratic Republic of the Congo reaching South Sudan, western Uganda; and south across Equatorial Guinea and Gabon to parts of Republic of Congo and into northern Angola.



Description: 30 cm. Male 101–122 g; female 84–115 g. The smallest hornbill in the world. Unmistakable appearance; dark reddish-chestnut plumage; wing coverts and flight and outer tail feathers tipped white; lower breast to abdomen white. Male has red bill and small ridged casque, and white eyes; female is smaller with shorter casque and black tip to bill. Juvenile resembles adult but bill smaller and pale orange. The call is a far-reaching series of some 15 mellow notes starting with a single note and followed by longer double notes falling in pitch *hoo hoo-oo hoo-oo hoo-oo*. Also makes a single fluty *kolong* between main calls. It calls all year, often with several birds calling together in a canopy chorus that can be heard 500 m away.



Red-billed Dwarf-hornbill; male, looking for food, Dja Wildlife Reserve, Cameroon. Paul Noakes



Red-billed Dwarf-hornbill; male, Sierra Leone. Jon Hornbuckle

Ecology and habits: Occurs in primary evergreen forest, secondary forest and forest edges and fragmented patches. Mainly in the lowlands, and often in swampy and riverine forest; in the Congo region recorded in hills up to 1,350 m elevation. Moves below the canopy in the dense mid-storey level of the forest, from below 20 m up in the trees down to the forest floor. Here it catches invertebrates

such as grasshoppers, crickets, beetles, mantids, wasps, caterpillars and many ants. Occasionally it also takes vertebrate prey like lizards, but rarely fruits. It is an agile and active feeder that hops squirrel-like along and between branches, gleans prey from small branches, foliage and creepers, and flutters quickly to the next perch. It moves in pairs, but more often as small social co-operative groups of 4–6 individuals, occasionally up to 12 birds. It often mixes with other bird species in mixed-species feeding flocks, so-called 'bird waves'. It also follows squirrels and driver-ants to grab the insects they stir up. It is probably territorial and sedentary throughout the year.

Breeding ecology: The nesting habits are little known. The egg-laying happens in Feb–Sep and Nov–Dec in West Africa, in Oct–Dec in Central Africa. The nest is a natural cavity in a tree, one was 14 m off the ground.

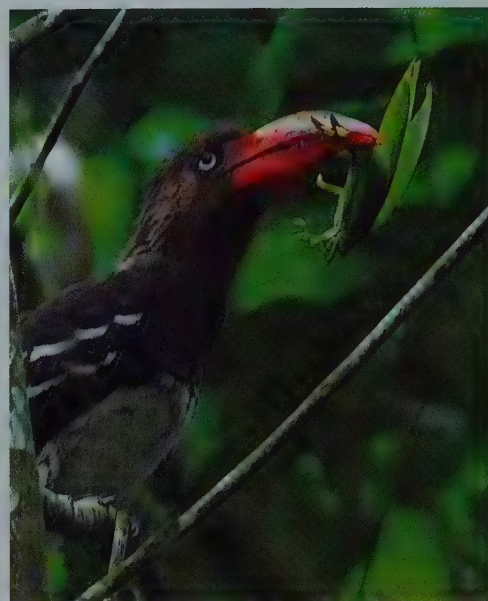


The entrance hole is sealed to a narrow slit. The breeding is probably co-operative, as social groups seem to travel and call together all year, most likely a dominant alpha pair being assisted by helpers. A captive pair was observed displaying together at the nest, bouncing up and down with wings spread. Clutch size and incubation period are not known; the female will emerge half-way through the nesting cycle and help the male with feeding the chicks. During a captive breeding event, the total nesting cycle was 81 days, and two chicks fledged. More studies of breeding ecology are required for this species.

Status: This hornbill has a large although somewhat fragmented range covering over 1.2 million km². Reported as widespread and common in many locations within this range, although easily overlooked in the forest; it is best located by call. One survey recorded it about every 800 m along a 32 km tract of riverine forest. Somewhat tolerant of habitat disturbance and can adapt to secondary growth; reported from one patch of forest in Gabon covering only 20 ha. The world population has not been estimated, but it appears to be substantial and stable; the species is not considered threatened with global extinction.



Red-billed Dwarf-hornbill; male, Gabon. Adriaan Dijkse



Top and above: Red-billed Dwarf-hornbill; male with prey, Cameroon. Paul Noakes

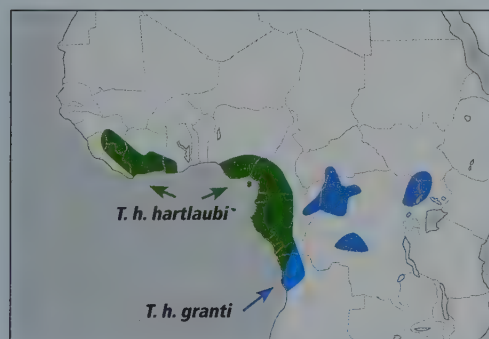
BLACK DWARF-HORNBILL

Tockus hartlaubi (*Tockus hartlaubi* Gould, 1861)

Taxonomy:

There are two subspecies:
T. h. hartlaubi occurs from southern Sierra Leone and Guinea east to western Ghana, then from southern Nigeria east to south-west Central African Republic and south to Democratic Republic of the Congo west of Congo River. *T. h. granti* occurs east of Congo River across the Congo Basin of the Democratic Republic of the Congo to South Sudan, western Uganda, and north-eastern Angola.

Distribution: West and Central Africa, from southern Sierra Leone and Guinea east across Liberia and Cote d'Ivoire into western Ghana; also from southern Nigeria through Cameroon, Equatorial Guinea, Gabon, Central African Republic and the Democratic Republic of the Congo, South Sudan, western Uganda and north-eastern Angola.



Description: 32 cm. Male 96–135 g; female 83–100 g. Small hornbill with dark grey, almost black upperparts and dark grey underparts; prominent white superciliary, lower belly and tip of tail are white. Nominate race male has plain wings, black casque and red tip to black bill and low casque ridge. Orbital skin grey and throat patches pink. Female is smaller with smaller bill and shorter all-black casque. Subspecies *T. h. granti* male has red casque and wing coverts and flight feathers tipped white. Juvenile is similar to adult female. The call is a



Black Dwarf-hornbill; *T. h. granti*, male calling, Uganda. Przemyslaw Kunysz

quiet series of high whistling notes *eep eep epp* atypical for the family. Gently raises and lowers its tail when calling.

Ecology and habits: Occurs in primary lowland evergreen forest, especially dense growth with many creepers and lianas; this species rarely extends into secondary forest. It also moves around the upper to middle stories of the forest, typically some 10–45 m off the ground. It often sits on a somewhat open perch at the edge of the canopy and flies out from there on rapid, flickering wings to glean prey from the stems and underside of leaves, or to hawk insects in the air. The main food is invertebrates; a large variety of prey has been reported such as beetles and grasshoppers, crickets, cicadas, mantids, butterflies, ants, termites, spiders, caterpillars and larvae. Also vertebrate prey including lizards and chameleons, but only rarely fruits. It moves in pairs or small family groups of up to 8 individuals. It sometimes follows troops of monkeys in the trees, and less often driver ants on the ground, to catch insects stirred

up. It is probably territorial and sedentary throughout the year.

Breeding ecology: The nesting habits are little known. Egg-laying occurs in Feb–Jun or mainly Oct–Dec in West Africa, during Jun–Dec in Central Africa. The nest is a natural cavity at 9–35 m up into a forest tree; often a knothole in the trunk or in a branch. The species is monogamous and probably territorial during breeding. The female seals herself inside the nesting cavity and leaves only a narrow slit. The clutch is probably up to 4 eggs, broods of 1–3 young having been reported. She is fed by the male carrying single animal items to the nest in the tip of his bill. One male in the Congo Basin area flew just 100 m to find food for the female. The female will probably emerge before the chicks are ready to fledge and helps the male with the feeding. After fledging, the young will stay with their parents for at least another month. However, incubation and nestling periods have not been documented, and more studies of the breeding ecology are required for this species.

Status: This hornbill has a very large although somewhat fragmented range covering almost 4 million km². It is considered generally uncommon but probably locally common. It is secretive, quiet and easily overlooked during forest surveys. One pair in Gabon had a fairly small home range of only 20–30 ha. However, the species prefers primary forest, so it is at risk when forest is disturbed by logging and development. It occurs in many protected areas, such as Gola NP in Sierra Leone, Tai NP in Cote d'Ivoire, Kakum NP in Ghana and Ipassa Makokou Biosphere Reserve in Gabon. The world population has not been estimated, but for lack of better data, it is presumed to be substantial and stable; therefore the species is not considered threatened with global extinction.





Black Dwarf-hornbill; nominate race, male (top) and female (above) near nest, Gabon.
Ron Hoff



Black Dwarf-hornbill; nominate race, male calling, Ghana. Nik Borrow

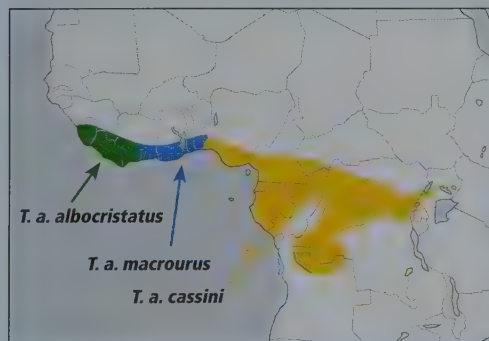
WHITE-CRESTED HORNBILL

Tropicranus albocristatus (*Buceros albocristatus* Cassin, 1848)



Taxonomy: Sometimes placed in genus *Tockus*; also placed previously in genus *Berenicornis* together with White-crowned Hornbill *B. comatus* of South-east Asia; it appears however, to be sufficiently distinct in aspects of morphology, voice and ecology to merit treatment in its own genus. There are 3 subspecies: *T. a. albocristatus* in the far west of the range from southern Guinea east to western Ivory Coast, *T. a. macrourus* from eastern Ivory Coast east to Benin and *T. a. cassini* from Nigeria east to Uganda and south to Angola.

Distribution: West and Central Africa including Guinea, Sierra Leone, Liberia, Cote d'Ivoire, Ghana, Togo, Benin, Nigeria, Cameroon, Central African Republic, Equatorial Guinea, Gabon, Republic of Congo, Democratic Republic of the Congo, Uganda and northern Angola.



Description: 70 cm. Male 279–315 g; female 276–288 g. Slender hornbill with black plumage and white tip to long tail feathers. White crest and long graduated tail tipped white are diagnostic features throughout range. Puffy white feathers on head are somewhat variable with area: *T. a. albocristatus* has full white head; *T. a. macrourus* has white head as well as neck; *T. a. cassini* is larger with only white crown but also white tips to



White-crested Hornbill; subspecies *T. a. cassini*, male, Gabon. Nik Borrow



White-crested Hornbill; subspecies *T. a. cassini*, female. Jon Hornbuckle

upper wing coverts and flight feathers. Bill and small casque are black with a creamy spot on posterior half of upper mandible. Bare skin around eyes is deep blue; eyes cream-coloured; small bare patch on throat pinkish. Female is smaller with smaller bill and shorter casque. Juvenile has small greenish almost casqueless bill. Typical call is a series of crowing notes followed by a rasping howl: uoo-uoo-uoo-ahh-ahh. Also a short contact call: squark.

Ecology and habits: This species is found in a wide variety of forest types but seems to prefer dense tangled growth within primary forest. Found in tangles within tall gallery forest as well as secondary growth and thinner, deciduous woodlands, from the lowlands up to 1,500 m elevation. It is a quiet and inconspicuous bird unless calling, which



White-crested Hornbill; subspecies *T. a. macrourus*, male, Ghana. Nik Borrow



White-crested Hornbill; subspecies *T. a. macrourus*, male, Ghana. Werner Suter

can easily be overlooked as it moves inside or below the canopy among the darker areas of the forest, some 2–30 m off the ground. It is an active feeder and moves among lianas and vines in a constant search for prey; it will also descend to the ground in pursuit of small animals or to pick up fallen fruits. The food is mainly invertebrates, especially insects, but also spiders and snails, with some vertebrate prey such as lizards, snakes, small mammals and bird nestling. It also feeds sometimes on fruits. It is often associated with moving troops of monkeys, driver ants or mixed species flocks of birds, so-called ‘bird waves’, which all help to stir up prey for the hornbills. It is presumed to be territorial and sedentary in most areas.

Breeding ecology: The nesting season is largely aseasonal; egg-laying has been recorded in Jan–Feb, Apr and Aug–Nov in west Africa, and in Jan–Feb, Jun–Aug and Oct–Dec in central Africa. It is territorial and breeds in pairs, each territory often shared with a troop of monkeys. The nest is a natural cavity at 10–16 m up into a tree or a palm stump. The female enters and seals the opening with her own droppings; she lays 2 eggs and moults her flight feathers during the confinement. The male feeds her and later the chicks in the form of mainly insects, delivers single item in the bill tip. However, incubation and nestling periods have not been recorded. In captivity, the female is reported only leaving the nest when the chicks fledge.

Status: This hornbill occurs over a huge range of some 1.5 million km², and it is locally common where the right habitat is available. Habitats are now somewhat patchy and fragmented, especially in the western parts of its range. In the Zwedru and Glaro districts



White-crested Hornbill; nominate race, female (notice black wings), Ghana. Nik Borrow

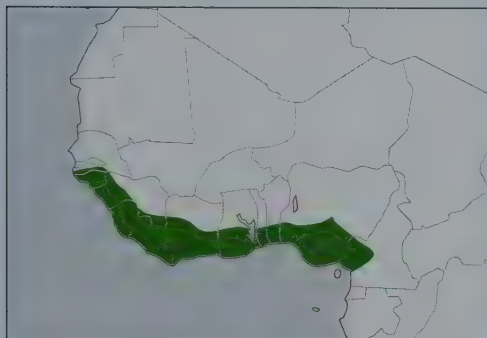
of Liberia high densities of 3–4 pairs per km² have been recorded. It is somewhat tolerant regarding type of forest, although it thrives best where troops of monkeys are also present, and these symbionts are among the first to be hunted for bushmeat. The population size has not been estimated but it is believed to be substantial, and the species is not considered threatened with global extinction.

YELLOW-CASQUED HORNBILL

Ceratogymna elata (*Buceros elatus* Temminck, 1831)

Taxonomy: Monotypic.

Distribution: West Africa from south Senegal along the coast east to south-west Cameroon.



Description: 60–70 cm. Male 2100 g; female 1500–2000 g. Large black hornbill with all-white outer tail feathers. Naked skin around eyes and on bare wattles below throat is blue. Differs from the Black-casqued Hornbill, where they overlap, by smaller cream-coloured casque (male) and by scaly white pattern on neck (both sexes). Male has black crown and large black bill with creamy cut-off casque; female has brown head with yellowish-brown bill and smaller casque. Juveniles of both sexes are like adult female but bill almost casqueless and smaller. The call is a loud resonant braying *aa-aa-a*. Also makes a hoarse croaking contact call.

Ecology and habits: Occurs in primary evergreen forest, mainly in the lowlands and often around swampy areas and riverine gallery forest; extends into closed secondary growth and nearby plantations, recorded in hills up to 1,000 m elevation. Here it moves high in the large trees, 30–50 m off the ground where it feeds mainly on fruits. Often feeds on oil- and other palm fruits, but is also takes animals such as insects and millipedes. Occasionally descends to the



Yellow-casqued Hornbill; immature male, Sierra Leone. Jon Hornbuckle

ground to pursue prey or pick up fallen fruits. It usually moves around in pairs or in small groups of up to 12 birds; also mixes with other hornbills such as the Brown-cheeked and Black-casqued Hornbills. It can fly far across the forest on whooshing wings to get to good fruiting trees, with ten-fold inter-seasonal variation in numbers in Cote d'Ivoire. As such it can range widely and has been known to gather at communal roosts with up to 50 birds roosting together, low down at 3–7 m up in swampy vegetation. Predation by African Crowned Eagle *Stephanoaetus coronatus* is reported.

Breeding ecology: The nesting habits are little known. Lone males have been seen in Sep–Mar, which is presumed to be the breeding season and coincides with the start of the oil palm fruiting. A pair has been seen visiting a natural cavity at 35 m up into a large forest tree, and uses of *Syzigium* (Myrtaceae), *Schefflera* (Araliaceae), *Canarium* (Burseraceae)



Yellow-casqued Hornbill; adult male displaying. Notice the expanded tail and inflated throat and wattles never before documented photographically. Jon Hornbuckle



Yellow-casqued Hornbill; immature pair, male below, Sierra Leone. Jon Hornbuckle





Yellow-casqued Hornbill; adult male. Jon Hornbuckle



Yellow-casqued Hornbill; female calling, also the first time the inflated throat and wattles have been reported and documented photographically. Sierra Leone. Jon Hornbuckle

and *Uapaca* (Euphorbiaceae) trees have been reported. In Korup NP, Cameroon, at least 17 nest sites are reported. Otherwise there is no information available regarding clutch size, incubation and nestling periods or other aspects of breeding ecology.

Status: This hornbill occurs over a large range of some 400,000 km², although total suitable habitat left may only cover around 35,000 km². It is generally a low-density species, and much habitat has been lost or fragmented due to human developments outside of forest reserves. It does show some tolerance for disturbed habitat, but the species is heavily hunted around plantations and settlements. It can be locally fairly common in some large protected areas such as Basse Casamance NP in Senegal, Tai NP in Cote d'Ivoire and Korup NP in Cameroon, but has declined in the latter after termination of the Korup Forest Project. BirdLife International has estimated that in 2012 the population was very small in Senegal; 419 in Mali and Guinea; 624 in Guinea-Bissau and Sierra Leone; 2,385 in Liberia, where much habitat has been lost; 3,871 in Cote d'Ivoire; 817 in Ghana, where hunting is a serious problem; a few records in Togo; 1,625 in Benin and Nigeria, and 2,791 in Cameroon. The total world population is estimated to be about 12,500 individuals with about 0.35 birds per km² of suitable habitat. However, the population appears to be declining rapidly throughout its range; in those places where primary forest used for reproduction has been cleared to critical levels there seem few chances of recovery. Considering this, the species was uplisted in 2012 from Near Threatened to Vulnerable with global extinction.

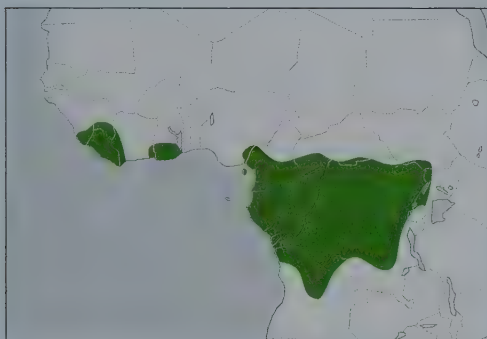
BLACK-CASQUED HORNBILL

Ceratogymna atrata (*Buceros atratus* Temminck, 1835)



Taxonomy: Monotypic.

Distribution: West and Central Africa from south Guinea and Sierra Leone, east to South Sudan and west Uganda and south to north-west Angola; also on Bioko Island (Equatorial Guinea).



Description: 60–70 cm. Male 1069–1600 g; female 907–1182 g. Large black hornbill with white tip to tail. Bare skin around eye and wattles below throat is blue. Differs from the Yellow-casqued Hornbill, where they overlap, by huge black casque (male) and by lack of white scales on neck plumage (both sexes). Male has all-black head and large black bill and casque; female is smaller with brown head and neck and horn-coloured bill with much smaller casque. Juveniles of both sexes resemble adult female in plumage but bill is almost casqueless and smaller. The call is a powerful nasal braying *wha-owha-o wha-a-a-awwhaaaw* that can be heard 2 km away. Both sexes call; male's call is louder and deeper. The male also gives a loud resonant *squark*, and a soft chuckling in alarm. Inflation of throat and wattles when calling not yet reported for this species.

Ecology and habits: Occurs in primary evergreen forest, mainly in the lowlands but extends into hill forest up to 1,500 m elevation. It is also found in mature secondary



Black-casqued Hornbill; female, Ghana. Nik Borrow



Black-casqued Hornbill; male, Gabon. Nik Borrow



Black-casqued Hornbill; male, Sierra Leone. Jon Hornbuckle

growth and nearby plantations. Here it feeds mainly high in the large trees, but it occasionally comes down to the ground to pursue prey or pick up fallen fruits. 94% of the food is fruits, mainly figs and especially oil-palm fruits; fruits from at least 21 plant families and 39 genera have been identified as food sources. The remaining 6% is animal prey such

as insects; it has been seen hawking for flying insects above the forest canopy, especially termite and ant alates; nests of weaver birds are also raided. Most hornbills never drink water, but this species has been observed drinking on several occasions. It usually moves around in pairs or in family groups, but flocks up to 40 birds have been recorded. Home ranges of

up to 36 km² have been measured, but when flocking it will wander far across the forest in search of fruiting trees, covering a distance of at least 64 km, with four- to ten-fold inter-seasonal variation in numbers in Cameroon and Cote d'Ivoire respectively. Flocks will gather in the evening at favourite roosting sites; the roosting branches are usually 20–50 m off the ground in dry forest, but as low as 5–8 m in swamp forest.

Breeding ecology: The nesting habits are little known but the breeding ecology is rather well studied in Cameroon. The timing is probably aseasonal over this wide range; female lays eggs around Dec–Feb in Liberia, Jul–Sep in the rest of West Africa and during Apr, Jan–Jul and Oct–Dec in Central and East Africa. In Cameroon egg-laying was during May–July when fruiting was increasing, although only in years of plentiful fruit resources. 0–25 nests were active in one season over four years on a 25 km² study area in Cameroon, so it probably does not breed every year. The breeding is possibly co-operative, with groups of up to 5 birds participating, mainly females and unsexed juveniles. The nest is a natural cavity at 10–24 m up in a large forest tree, mostly in the trunk of one of 17 species of live trees, with a mean internal diameter of 35–45 cm, a chimney about 150 cm high above the entrance and the floor 47 cm below. The entrance was usually oval, about 10 cm wide and 14 cm high, and faced slightly downwards. The female enters, and both the female and the male seal the nesting hole together with mud pellets swallowed and brought in by the male. The clutch is 1–2 eggs, but usually only a single juvenile is seen later with the parents. There is no information available regarding incubation and nestling periods. Fruits delivered to nests in Cameroon were predominately from five

plant species, with those of rattan palms being most important, augmented by more small animals when chicks were present. Nesting success to fledging varied from 0–67% over four successive years in Cameroon.

Status: This hornbill has a huge range over 2 million km²; within this range, total suitable habitat of old forest with suitable nesting trees has not been quantified, but it must be much smaller, fragmented and shrinking faster than previously, due to logging activities and expansion of human settlements in most range

countries. It is reported as common in only a few localities in West Africa, but has been eliminated from many areas in this part of its range due to habitat loss and hunting. It is more numerous in Central and East Africa but occurs everywhere at naturally low densities. It is found in several protected areas, such as Maraoué and Tai NPs in Cote d'Ivoire, Dja Reserve in Cameroon and La Lope NP in Gabon. The world population has not been estimated, but although it appears to be slowly declining, the species is not yet considered threatened with global extinction.



Black-casqued Hornbill; male. Pete Morris

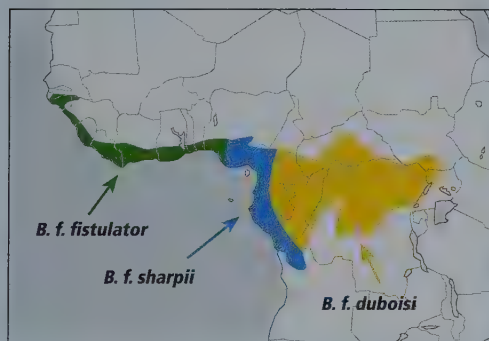
PIPING HORNBILL

Bycanistes fistulator (*Buceros fistulator* Cassin, 1850)



Taxonomy: Genus sometimes merged with *Ceratogymna*. There are 3 subspecies: *B. f. fistulator* in the west of the range from Senegal east to western Nigeria. *B. f. sharpii* overlaps in eastern Nigeria, but extends to Cameroon, Equatorial Guinea, Gabon, Republic of the Congo, western Democratic Republic of the Congo and northern Angola. *B. f. duboisi* overlaps in Cameroon but extends into Central African Republic, South Sudan, across most of the Congo River basin in the Democratic Republic of the Congo and into western Uganda.

Distribution: West and Central Africa including southern Senegal, Guinea-Bissau, Guinea, Sierra Leone, Liberia, Cote d'Ivoire, Ghana, Togo, Benin, Nigeria, Chad, Cameroon, Equatorial Guinea, Gabon, Republic of Congo, Central African Republic, Democratic Republic of the Congo, Uganda and northern Angola.



Description: 45 cm. Male 463–710 g; female 412–500 g. It is the smallest among the *Bycanistes* hornbills with black head, neck and upperparts, white rump and underparts. Nominate race male *B. f. fistulator* has all-black wings and white tips to outer tail feathers. Bill and casque are dark with creamy base and heavy ridges; skin around eyes blue. Female is smaller with smaller, darker bill and casque.



Piping Hornbill; nominate race, immature male on left and adult female, Guinea. Nik Borrow



Piping Hornbill; nominate race, male, Nigeria. John Sawyer



Piping Hornbill; nominate race, adult pair, male on left, Nigeria. John Sawyer

Subspecies *B. f. duboisi* and *B. f. sharpii*, both are larger, with prominent white tips of secondaries and inner primaries as well as all-white outer tail feathers. Both bill and casque are creamy; *B. f. duboisi* has significantly longer and higher casque than the other races. Juvenile is similar to respective adult but almost casqueless with smaller bill. The call is a loud raucous *kah-k-k-k-k* or a shrill piping *peep-peep-peep*. Also makes a short barking contact call.

Ecology and habits: This species is found in primary evergreen rainforest and surrounding closed secondary forest, mangrove forest and swamp forest, in the lowlands up to 600 m elevation. Generally sedentary, but extends into nearby plantations to feed. It feeds mainly on fruits at canopy level, some 30–50 m off the ground. 91% of food is fruits; identified from tree species of at least 12 families and 40 genera. It also eats flowers, buds and young leaves, as well as agricultural crops such as maize and oil-palm fruits. It lands near the target tree and moves in cautiously, staying up to 30 min in the same tree before moving on and often visiting the same tree the next day. It also takes some small animals and will fly out of the canopy to hawk for flying insects such as winged termites and ants; it can also descend to the ground to follow driver-ants in search of prey. Mainly moves in family groups within a territory. Certain times of the year it will range widely in small flocks of 12–20 individuals, flying more than 6 km in one day within its range in search of fruiting trees and flying high above the canopy. It may also roost communally; flocks of up to 37 birds have been reported.

Breeding ecology: The nesting season is probably aseasonal; egg-laying has been recorded in Jan, Apr, Jun and Oct–Dec in West Africa, and in Jan–Feb, Apr, Jul and Sep–Dec in Central and East Africa. The nest is a natural cavity at 8–15 m up into a tree. The clutch is 1–3 eggs, but usually only one chick is reared. Otherwise the breeding ecology is little known; incubation and nestling periods have not been recorded.

Status: This hornbill occurs over a huge range of some 2.5 million km², and it is generally common across much of this area; it can be found in most forest reserves. Outside of



Piping Hornbill; subspecies *B. f. duboisi*, pair, male on left, Uganda. Tom Tarrant



Piping Hornbill; subspecies *B. f. sharpii*, male, Cameroon. Gabi Bujanowicz



Piping Hornbill; subspecies *B. f. sharpii*, female, Cameroon. Gabi Bujanowicz

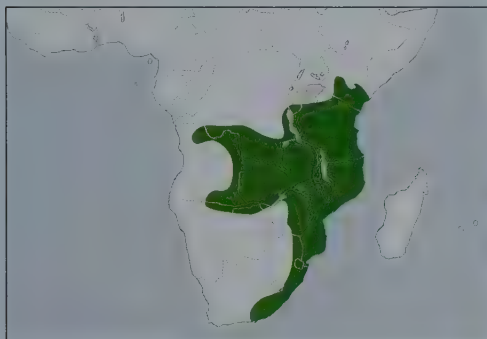
protected areas it is fairly tolerant regarding habitat and can exist in secondary growth and agricultural regions with tall trees as long as mature forest is nearby. The world population has not been estimated, but it appears to be substantial and stable, and the species is not threatened with global extinction.

TRUMPETER HORNBILL

Bycanistes bucinator (*Buceros bucinator* Temminck, 1824)

Taxonomy: Monotypic. Genus sometimes merged with *Ceratogymna*.

Distribution: Sub-Equatorial Africa; north and north-east Angola and southern Democratic Republic of the Congo east to East Kenya, and from there south to northern Namibia and Botswana, Zimbabwe and eastern South Africa.

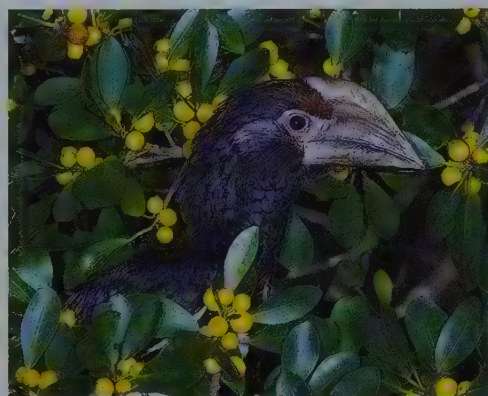


Description: 50–55 cm. Male 607–941 g; female 452–670 g. Medium-sized hornbill with black plumage apart from all-white belly, rump, underwing coverts and tip of wings and tail. Bare skin around eyes is red. Bill and casque are black. Male has large and high casque extending to tip of bill with dark reddish-purple orbital skin; female is smaller and has smaller bill and short casque with yellowish base. Juvenile is similar to adult, but almost casqueless bill with brown-tipped feathers at base and on cheeks. The call is a loud nasal wailing *nhaa nhaa ha ha ha ha*. Also produces braying notes in flight.

Ecology and habits: Found in tall, riverine and coastal evergreen forest as well as deciduous woodlands and montane forest up to 2,200 m elevation. Here it feeds mainly on a wide variety of fruits from at least 14 different genera, especially figs but also berries and drupes as well as cultivated varieties where available, such



Trumpeter Hornbill; male, Kafue National Park, Zambia. Marie-France Granouillet



Trumpeter Hornbill; juvenile male. Hugh Chittenden

as papaya, mangoes and lychee. It feeds inside the dense foliage where it takes some animals, flying insects, caterpillars, millipedes, woodlice, crabs and small birds and nestlings. It is mainly resident but will roam widely in search of fruiting trees, sometimes flying at least 10 km across the savanna between patches of forest. It is most often found in pairs or family groups of 3–5 birds, but regularly gathers in small flocks of up to 48 birds; up to 100 birds may feed in the same general area. In the evening it gathers from as far as 15 km away to roost in flocks of up to 200 individuals; they roost in large trees, often near a river but also in gorges in remote dry deciduous forest. At dawn, the birds head out in pairs or in small groups in different directions to find fruiting trees.



Trumpeter Hornbill; male. Hugh Chittenden



Trumpeter Hornbill; female. Philip Stapelberg

Breeding ecology: The eggs are laid during the southern spring and summer from Sep–Jan. The nest is a natural cavity at 2–13 m up in a tree or in a rock face. This species is monogamous, but sometimes a second male or a yearling will assist as a helper to bring food. The pair will start to visit and inspect the nesting site and the cavity up to two months before nesting starts. The nesting cavity is lined with bark and wood flakes; the pair engages in courtship feeding, and after mating the female enters the nest. The male brings in and regurgitates mud pellets to seal the opening; both sexes help with the sealing, with the female also using her own droppings. After 10–15 days in the nest, the female lays 2–4 eggs at intervals of 2–3 days. The male feeds her and

later the chicks with regurgitated food; he may fly up to 8 km from the nest to find fruiting trees and bring up to 38 food items per visit. Deliveries to one nest were 89% fruit and 11% animals. The female moults her flight feathers during the incarceration and regrows new ones before emergence. The incubation period is 28 days, nestling period is at least 50 days, the female and the chicks breaking out of the nest together at the end. The chicks are weak fliers in the first 2-3 days after leaving the nest and will stay in the vicinity; after 5-7 days they can fly with the parents and join them in feeding.

Status: This hornbill occurs over a huge range of over 4 million km². Although it occurs generally at low densities, it is reported as locally common in many areas, including many protected national parks and forest reserves, and is capable of extensive local movements between habitat patches. It is fairly tolerant regarding habitat and can exist in secondary growth, and even nearby agricultural and suburban regions. The population has not been estimated, but it appears to be substantial and stable, and the species is not threatened with extinction.



Trumpeter Hornbill; female, Kafue NP, Zambia . Pete Morris



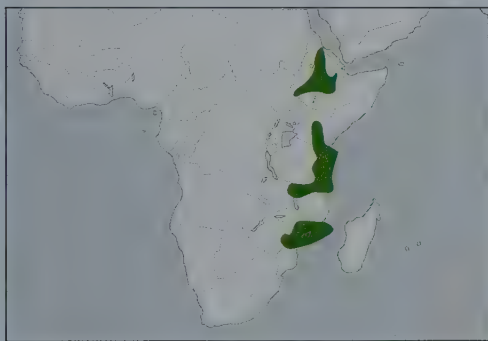
Trumpeter Hornbill; immature female, South Africa. Con Foley

SILVERY-CHEEKED HORNBILL

Bycanistes brevis (*Buceros cristatus brevis* Friedmann, 1929)

Taxonomy: Monotypic. Genus sometimes merged with *Ceratogymna*. In the past, northern population sometimes treated as subspecies *omissus*.

Distribution: There are three widely separated populations: Ethiopian Highlands, S Sudan and N Malawi; S Malawi and central Kenya south to southern Tanzania; and Malawi and central Mozambique to south-east Zimbabwe. Vagrant to north-east Zambia and possibly north-east South Africa.



Description: 60–70 cm. Male 1265–1400 g; female 1050–1450 g. Fairly large black hornbill with silvery-grey spots on cheeks and bright white abdomen, lower back, rump and tip of tail. It is unmistakable from the sympatric but smaller Trumpeter Hornbill by its large creamy-white casque and silvery-grey cheeks on large head. Male has a massive creamy casque and yellow band across the base of dark brown bill, bare blue skin around brown eyes; female is like male but smaller with small, darker casque. Juvenile lacks silvery cheeks and has smaller almost casqueless bill. The call is a loud braying and growling *quark quark quark*. Also some softer grunting contact notes while feeding.

Ecology and habits: Found in a variety of forests and woodlands from evergreen coastal forest to riverine and tall deciduous forests



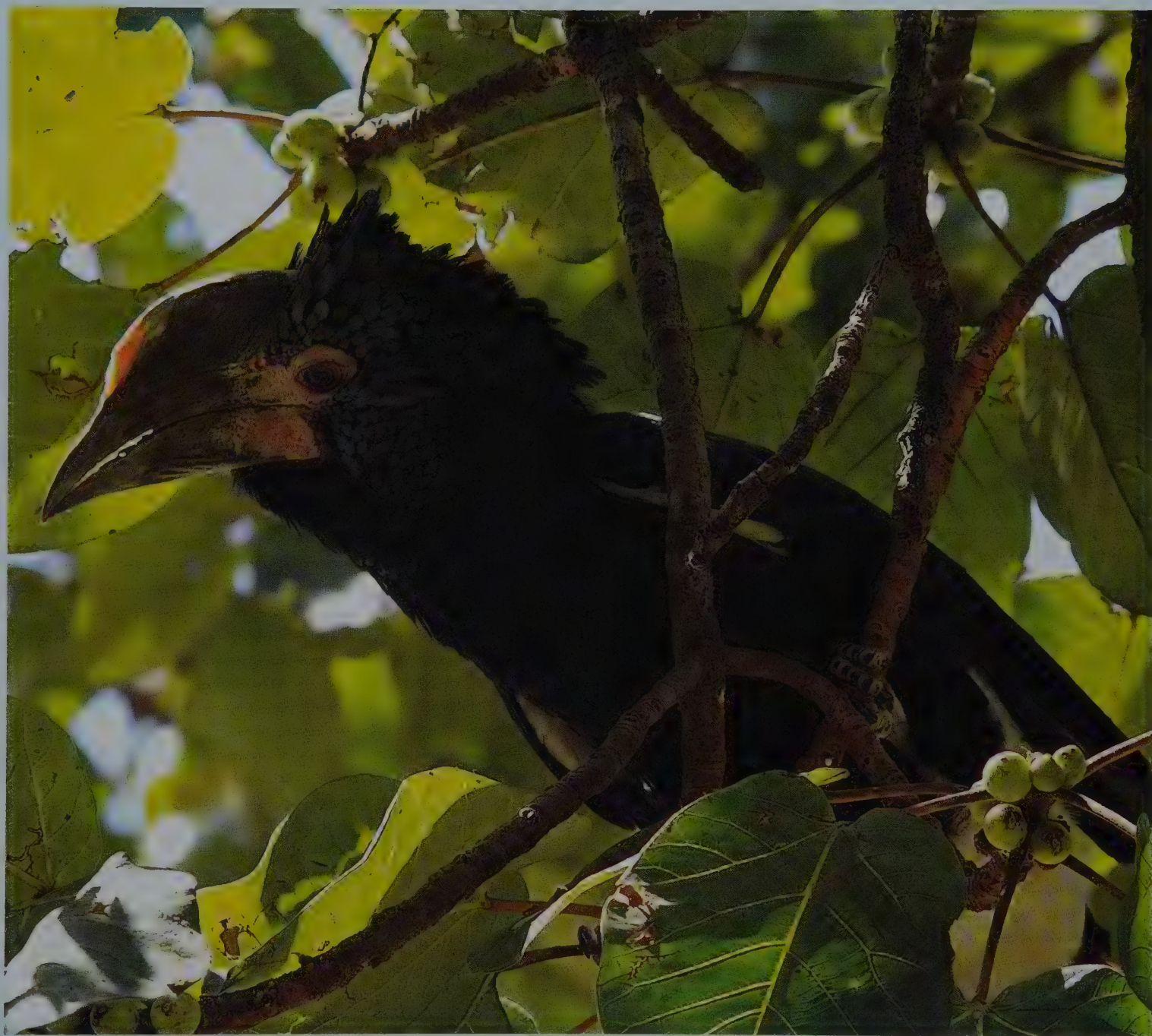
Silvery-cheeked Hornbill; immature male, Ethiopia. Ron Hoff



Silvery-cheeked Hornbill; male, Kenya. Shailesh Patel



Silvery-cheeked Hornbill; male with fruit, Ethiopia. Marie-France Granouillet

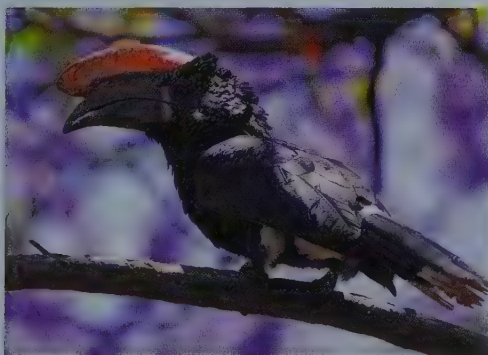


Silvery-cheeked Hornbill; female, Ethiopia. Adriaan Dijkse

SILVERY-CHEEKED HORNBILL



Silvery-cheeked Hornbill; male, Ethiopia.
Marie-France Granouillet



Silvery-cheeked Hornbill; male, Ethiopia.
Marie-France Granouillet



Silvery-cheeked Hornbill; male, Ethiopia. Adriaan Dijkse

in the hills up to 2,600 m elevation. It feeds mainly on fruits, its diet a wide variety from at least 26 different plant genera, especially figs and cherry-sized drupes. It feeds in the canopy but can also descend to the ground to pick up fruits or pursue prey. Animal prey includes mainly insects, as well as spiders, centipedes, lizards, fruit bats and birds and their nestlings. It may fly far to find fruiting trees and may return to the same fruiting tree daily for 3 months. Outside of the breeding season and during dry spells it becomes nomadic and may turn up far from its home range. It usually moves in pairs or as a family group together. Juveniles can form separate flocks together, and larger feeding flocks numbering up to 100 birds have been reported at good fruiting trees or feeding on swarms of locusts. It gathers at communal evening roosts, where up to 200 birds have been recorded in tall roosting trees, often segregated by sex; sometimes it mixes here with Trumpeter Hornbills. It calls more in the morning, evening and when in larger groups, possibly for information sharing around roosts.

Breeding ecology: The eggs are laid in Feb-Jul in the northern part of the range; in Oct-Nov in Kenya and further south. The nest is a natural cavity at 7-25 m up in a large tree. This species is monogamous and breeds in pairs; the male will ferociously chase other males out of the nesting area. After the female enters the nest, the male will bring mud pellets to seal the opening; both sexes help with the sealing. The clutch is 1-2 eggs. The male feeds the female and later the chick(s) with regurgitated food; one survey found that he made up to 24 visits per day, in the beginning of breeding 10-14 visits, after the chicks hatched increasing to 21-24, and then declining to 16-19 visits towards the end of the nesting cycle. During each visit the male may bring up to 69 fruits; on average 100-300 fruits (about 360 g) were delivered per day. It was estimated that 24,000 fruits were delivered in total during 1,600 visits over the entire nesting cycle. The incubation period is 40 days; nestling period is 77-80 days. Usually only one chick will fledge, rarely two. The female and the chick will break the sealing



Silvery-cheeked Hornbill; immature and adult males sunning, Ethiopia. Raphael Jordan



Silvery-cheeked Hornbill; female, Ethiopia. Ron Hoff



Silvery-cheeked Hornbill; adult pair, male on left.
Philip Stapelberg

plaster and emerge from the nest together. The total nesting cycle is 107-138 days. Breeding is somewhat erratic; each pair may not breed every year even where suitable nesting holes are available.

Status: This hornbill occurs over a somewhat fragmented but large range covering over 700,000 km². Within this range, the distribution is patchy and somewhat erratic, and the species is generally at low density and uncommon. It is susceptible to drought conditions and human habitat degradation; rare vagrant to northern South Africa, but still locally common in Zimbabwe and adjacent Mozambique; it is doing better in the central part of its range where it is still locally common. It is somewhat habitat tolerant and mobile, and can adapt to various types of forested terrain. The world population has not been estimated, but for lack of better data it must be presumed to be stable, and the species not yet threatened with global extinction.

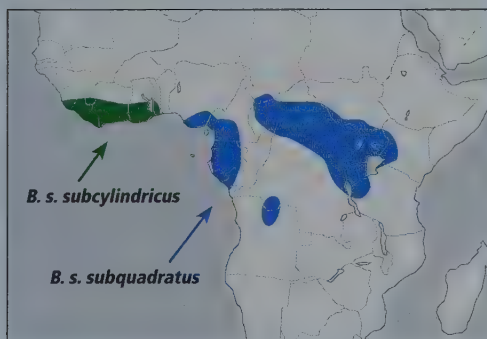
BLACK-AND-WHITE-CASQUED HORNBILL

Bycanistes subcylindricus (*Buceros subcylindricus* P.L. Sclater, 1870)



Taxonomy: Genus sometimes merged with *Ceratogymna*. There are currently 2 rather poorly differentiated subspecies: *B. s. subcylindricus* in the west of the range including Sierra Leone, Liberia, Cote d'Ivoire, Ghana and Togo; and *B. s. subquadratus* from east Nigeria, Cameroon, Central African Republic and southern Chad east to South Sudan, and south to Democratic Republic of the Congo, northern Angola, western parts of Kenya and Tanzania, and Rwanda and Burundi.

Distribution: Patchy range along northern and eastern tropical rainforests, and in northern Angola, including the West, East and Central African countries mentioned.



Description: 60-70 cm. Male 1078-1525 g; female 1000-1250 g. Male, from male Brown-cheeked and White-thighed Hornbills where they overlap, by mainly black bill and casque as well as tail pattern. Fairly large hornbill; black head with grey cheeks, black upper half of body with white rump and lower half of underparts; wings black with broad white edges; tail black with white half of outer feathers. Bill and most of casque black; large casque has creamy patch extended from posterior end. Bare skin around eyes is red. Female is smaller, with smaller all-black bill and casque and pink orbital skin. Subspecies *B. c. subquadratus* resembles nominate race, except



Black-and-white-casqued Hornbill; male, Uganda.
Kris Blachowiak



Black-and-white-casqued Hornbill; immature female, notice brown feathers at base of bill, Uganda.
Kris Blachowiak



Black-and-white-casqued Hornbill; pair, male below, Uganda. Ron Hoff

for more white on belly and more extensive creamy patch on anterior half of casque; all our photographs here show the former subspecies. Juvenile is similar to adult but almost casqueless with bill smaller. The call of subspecies: *B. s. subcylindricus* is a loud series of slowly repeated hooting notes; the call of *B. s. subquadratus* is a series of loud but less raucous quacking notes, faster, at higher pitch and audible up to 2 km. Also a hoarse contact call *ark*.

Ecology and habits: Occurs mainly in the transition zone between patches of evergreen and secondary forests; also occurs in tall deciduous woodlands and nearby cultivation areas; but always prefers primary forest with large trees for nesting. From sea level into hills

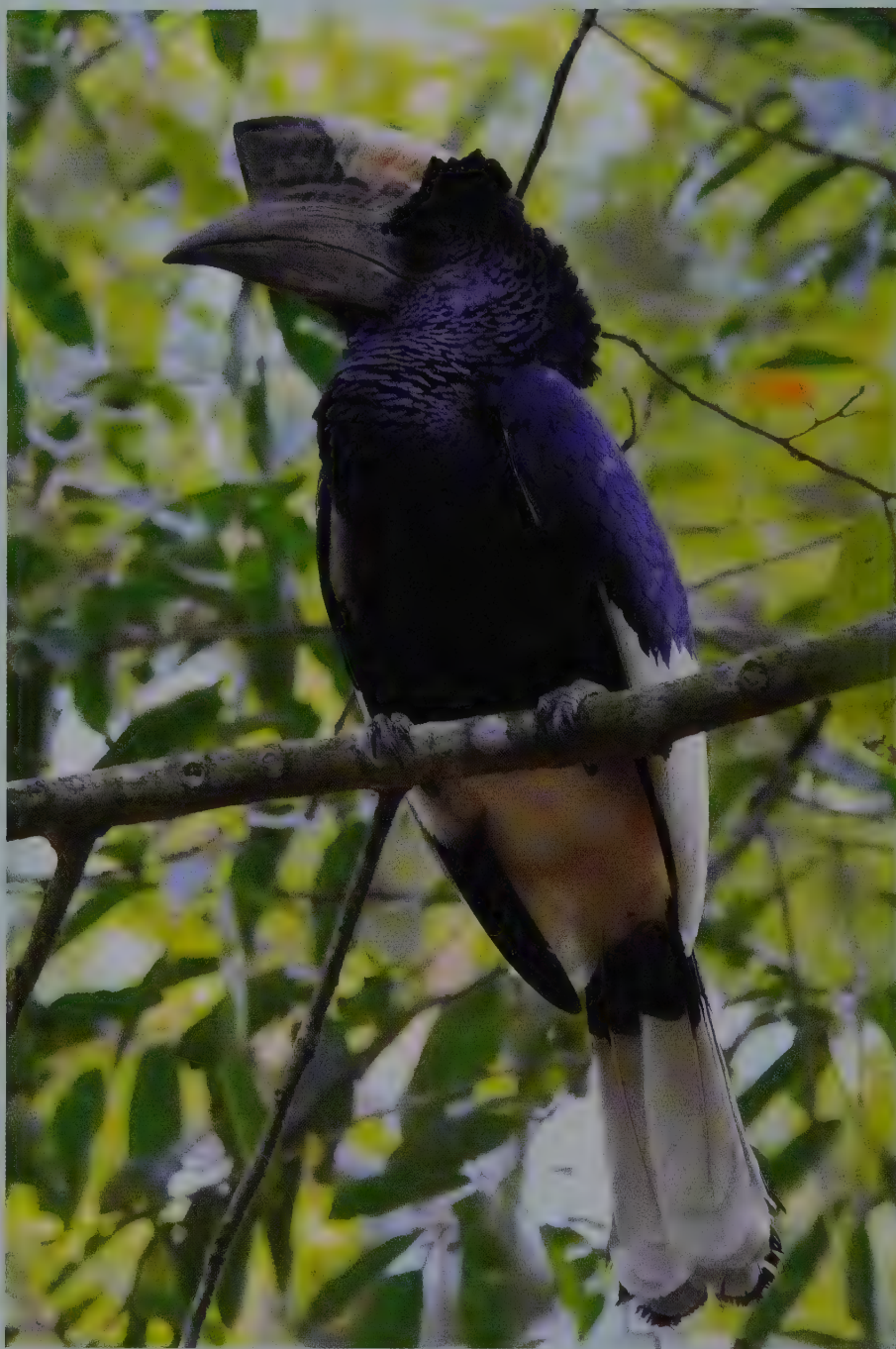
Facing page: Black-and-white-casqued Hornbill; pair, male on right. Pete Morris



BLACK-AND-WHITE-CASQUED HORNBILL

up to 2,600 m elevation. It feeds mainly on fruits (91% of the diet by volume in one survey); especially many figs (57% of fruits), but fruits from at least 41 tree genera have been identified. Fruits taken vary from 5–60 mm in size but are mainly pea to olive size. Has been recorded eating mosses, fungi and lichens as well. It also takes a variety of small animals, mainly insects such as beetles, moths, termites, caterpillars, crickets and mantids; but also millipedes, snails and vertebrate prey, including lizards, bats, bushbabies and other birds and their nestlings. It feeds mainly in the canopies of large trees, but it also comes down to the ground to pick up fallen fruits or to pursue prey with several individuals hunting together. A hunting group will crash through the trees actively hunting for other birds or roosting fruit bats. In the trees it often follows groups of monkeys or squirrels. It is largely sedentary and usually moves in pairs; the same pair will stay together for years. It will travel up to 6 km to get to a good fruiting tree, especially in the dry season. Might gather in flocks at good feeding sites, where 20–50 birds have been reported. Sometimes congregates in large loose flocks at roosting sites, but usually the resident pair will roost together using the same site regularly. This species can live up to 32 years in captivity.

Breeding ecology: Nesting is probably aseasonal over the large range; egg-laying has been recorded in Jan–May in Central Africa, but mainly during Aug–Mar in East Africa. The nest is a natural cavity at 9–30 m up into a tree, less often on a rock face. The pair is territorial and will chase other hornbills from the nesting site. The pair will inspect the nest and engage in courtship displays nearby, such as courtship-feeding, allopreening and head-shaking. The female enters the nest, but the male and the female will seal the opening together, mainly using mud pellets brought in and food regurgitated by the male; the female can also use her own droppings and fruit pulp if no mud is delivered. The clutch is 2 eggs, but usually only one chick is reared, the younger chick dying of starvation. The male feeds the female



Black-and-white-casqued Hornbill; male, Uganda. Tadasz Rosinski



Black-and-white-casqued Hornbill; male, Uganda. Gabi Bujanowicz



Black-and-white-casqued Hornbill; adult pair, male on right, Uganda. Marie-France Granouillet



Black-and-white-casqued Hornbill; male calling, Uganda. Ron Hoff



Black-and-white-casqued Hornbill; immature male, notice developing casque, pale orbital skin and brown feathers around eye and base of bill, Uganda. Tadeusz Rosinski



Black-and-white-casqued Hornbill; female, Uganda. Gabi Bujanowicz

56 nests in Uganda where the female sealed herself in, 36–66% reared at least one chick annually; only one nest reared two chicks. Food scarcity during dry years, flooding of nests, disturbance by monkeys and squirrels, predation by Crowned Eagle and competition from other Black-and-white-casqued Hornbill females reduced breeding success.

Status: Occurs over a huge range of almost 1 mill km²; however, within the range, suitable habitat has shrunk in recent years, and the number of known locations is small. It is local and uncommon in West Africa and in Angola, but still locally common in Central and East Africa, especially along the Congo River. It can be found in Kibira NP in Burundi and Bwindi Impenetrable Forest NP in Uganda. Can adapt to disturbed habitats along forest edges, but hunting often suppresses numbers in these areas. The world population has not been estimated, but it appears to be substantial and stable or in slow decline, and the species is not threatened with global extinction.

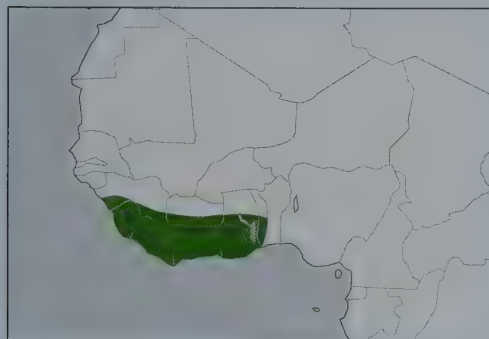
and later the chick with regurgitated food, mainly fruits; he can bring up to 200 fruits during one visit. The incubation period is 42 days; the nestling period is 70–79 days. The chick and the female usually leave the nest together in the morning, but the chick sometimes remains behind and seals itself in before leaving for good a day or two later. The whole nesting cycle is 115–142 days. The chick usually stays around the nest for a few days; then, when its wings are stronger, it will join the parents on feeding trips. Out of

BROWN-CHEEKED HORNBILL

Bycanistes cylindricus (*Buceros cylindricus* Temminck, 1831)

Taxonomy: Monotypic. Genus sometimes merged with *Ceratogymna*. White-thighed Hornbill *B. albotibialis* previously included as a subspecies within this species.

Distribution: West Africa from southern Guinea and Sierra Leone, east across Liberia, Cote d'Ivoire, Ghana, to Togo.



Description: 60–70 cm. Male body mass unrecorded; one female 921 g. Fairly large hornbill. Male differs from the sympatric male Black-and-white-casqued Hornbill by large creamy bill and high ridged casque, and prominent black band across white tail; head and upper half of body, belly and thighs are black. Broad white rump and white primaries in wing; bare skin around eyes carmine-red; feathers on cheeks are brown-tipped, giving the bird a tinged face. Female is smaller with smaller all-black bill and casque and pale pinky-cream orbital skin. Juvenile is similar to adult but with almost casqueless and smaller bill. The call is a series of harsh and coughing notes descending in tone *rack kack kak-kak-kak*. Also a single contact call *kack* and some piping notes reported. The large wings produce a loud whooshing sound.

Ecology and habits: Occurs mainly in primary lowland rainforest; less often found in closed secondary forest and nearby



Brown-cheeked Hornbill; female, Ghana. Raphael Jordan



Brown-cheeked Hornbill; female, Sierra Leone. Jon Hornbuckle

plantations. It feeds mainly on fruits high in the tree canopies, but also takes some animal prey, mainly insects such as beetles, mantids, grasshoppers, dragonflies and winged ants that it can catch in the air. It usually moves in resident pairs, but a flock of up to 6 birds may gather in good fruiting trees; a rare 30-year old record of 90 birds together in fruiting trees, and a recent three-fold inter-seasonal variation in numbers reported for Cote d'Ivoire, both suggesting patchy and fluctuating food supplies, albeit less so than for larger relatives. Reports from Liberia show that it becomes somewhat nomadic outside of the breeding season and roams far in search of favorable feeding sites; flocks of 50 birds have been observed.



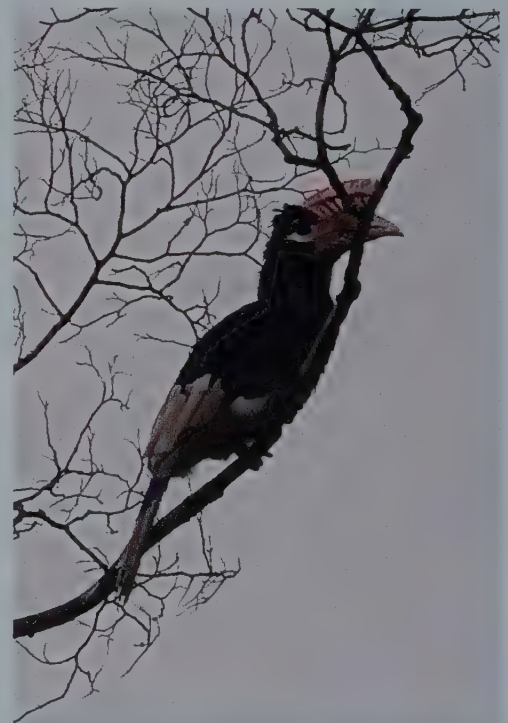


Brown-cheeked Hornbill; female, Ghana. Nik Borrow

Breeding ecology: The breeding ecology is not well studied; in Liberia lone males are found in Sep–Nov indicating breeding, and there is also a record from Ghana of a male feeding at a nest in Jan. The nest is a natural cavity at 20–25 m up into a tree. The clutch size is not known; usually only a single fledged chick is seen later with the parents. The male feeds the female in the nest with regurgitated foods, but there are few studies available for this species. There is also no information available on incubation and nestling periods.

Status: Occurs in a fairly small range; forest habitat within the range is highly fragmented and much of it is disturbed, logged over and converted to agriculture and human settlements. Although the species visits secondary forest and plantations, it appears to depend on primary forest with large old trees for breeding and it is usually the first hornbill species to disappear from selectively logged areas. It is uncommon throughout most of its range; in Sierra Leone it has been reported from the Loma Mountains, Western

Area Peninsula Forest and Kangari Hills Forest Reserves, and in Liberia from the Gola Forest Reserve. In Cote d'Ivoire it is reported as locally common in several protected areas such as Maraoue, Mount Peko and Tai NPs. In Ghana it has declined in numbers and appears uncommon, even in protected areas, such as Draw River, Boi Tano and Krokosua Hills Forest Reserves. Outside the protected areas it is hunted. The world population has not been estimated, but it is suspected to be undergoing a rapid decline owing to the impact of habitat destruction and degradation, and hunting pressure. This is probably the most threatened hornbill species in Africa, along with its cohabitant the Yellow-casqued Hornbill. In view of this, the species was uplisted in 2012 from Near Threatened to Vulnerable with global extinction.



Brown-cheeked Hornbill; male, Sierra Leone. Jon Hornbuckle

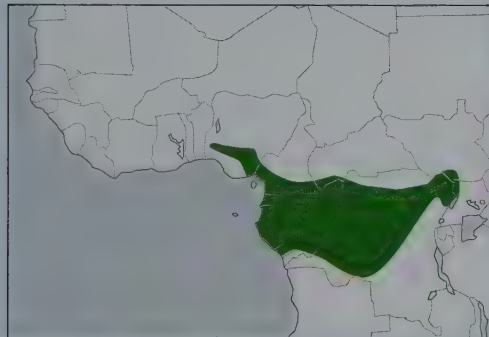
WHITE-THIGHED HORNBILL

Bycanistes albotibialis (Cabanis & Reichenow, 1877)



Taxonomy: Monotypic. Genus sometimes merged with *Ceratogymna*. Previously considered conspecific with Brown-cheeked Hornbill *B. cylindricus*.

Distribution: Central Africa from Benin east across Nigeria, Central African Republic, Democratic Republic of the Congo to South Sudan and western Uganda, and south across Cameroon, Equatorial Guinea, Republic of the Congo and Gabon into northern Angola.



Description: 60–70 cm. Male 1200–1411 g; female 908–1043 g. Fairly large hornbill with black head and top half of body including breast, belly and thighs white. Broad white rump and outer primary and secondary wing feathers; tail white with black band across middle. Bare skin around brown eyes is yellow. Male has large dark-creamy bill and paler long, high, pointed casque. Female is smaller with smaller all-black bill and casque. Male differs from male Black-and-white-casqued Hornbill where they overlap by largely creamy bill and pointy casque and black band across white tail; also look for yellow (not reddish) bare skin around eye. Juvenile is similar to adult but almost casqueless and bill smaller. The call is a series of harsh, coughing notes descending in tone *rack kack kak-kak-kak*. Also a single contact call *kack* and some piping notes reported. The large wings produce a loud whooshing sound.



White-thighed Hornbill; family displaying, male centre, female right and juvenile male left, Central African Republic. Werner Suter



White-thighed Hornbill; male, Uganda. Piotr Jonczyk

Ecology and habits: Occurs mainly in primary lowland rainforest up to an elevation of 1,000 m, but also found in closed secondary forest and nearby plantations. It feeds mainly on fruits, which constitute about 92% of diet. It takes fruits from at least 38 plant genera and 18 different families, including fig, nutmegs, rattan and oil-palm fruits. It feeds high, 25–50 m up in the large forest trees where it also picks up some prey such as insects and other birds and their nestlings; it flies out to hawk flying insects, especially termite and ant alates. In Uganda it has been reported to raid weaver birds' nests, tearing the nests apart and eating eggs and chicks. Usually 2–3 birds visit a fruiting tree



White-thighed Hornbill; male, Uganda. Tadasz Rosinski

WHITE-THIGHED HORNBILL



White-thighed Hornbill; male. Pete Morris

together, probably a family group. This species often mixes with other hornbills and animals in good fruiting trees, and it is dominant over the smaller sympatric Piping Hornbill but not the larger Black-casqued Hornbill or monkeys. It may stay up to 1 hr and 15 min in the feeding tree and eat 2-3 fruits per min. Home ranges of up to 4,500 ha have been measured, but it roams far to find fruiting trees, as far as 290 km, and also visits plantations and free-standing trees nearby forest, making it highly but erratically nomadic outside of the breeding season, with twelve-fold variations in local abundance in Cameroon.

Breeding ecology: The breeding ecology is rather well studied in Cameroon; there is no obvious breeding season across its wide range, with birds in breeding condition reported from various countries during Jan-Apr, Jun-Aug and Oct-Dec. In Cameroon egg-laying was during May-July when fruiting was increasing, although only in years of plentiful fruiting. The nest is a natural cavity at 18-25 m up, mostly in the trunk of one of six species of live trees, with a mean internal diameter of 41-50 cm, a chimney about 113 cm above the entrance and the floor 30 cm below. The entrance was usually round, about 10 cm in diameter, and faced slightly upwards. Two nests were 2.4 km apart and two other pairs lived in 3 km² of forest in Gabon. A maximum of 0-13 nests were active in each season over 4 years on a 25 km² study area in Cameroon. The clutch size is still not known, the eggs have never been described, nor the incubation and nestling periods. Two nestlings have been reported from Gabon, but often only a single fledged chick is seen later with the parents. The male feeds the female and chicks in the nest with regurgitated foods, with 12 fruits per visit and 14-18 visits per day reported from a nesting record near the Congo

river. Fruits delivered to nests in Cameroon were predominantly from five plant species with those of rattan palms most important, augmented by more small animals when chicks were present. Nesting success to fledging varied from 0-54% over four successive years in Cameroon.

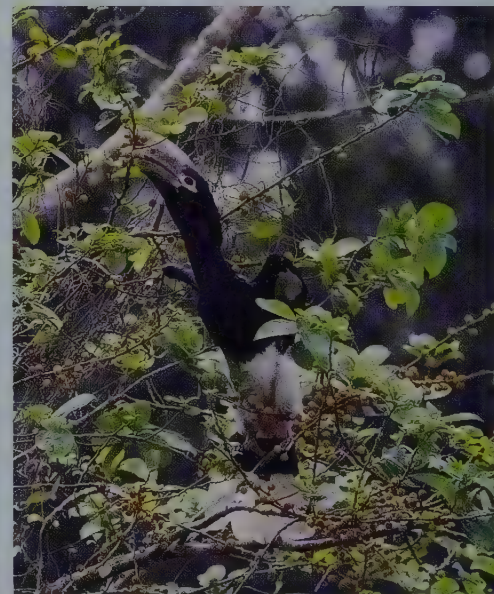
Status: Occurs over a huge range and is locally fairly common. Although it prefers primary forest for habitat, it shows some tolerance for disturbed areas and secondary forest, and may even nest more often in such habitats than its larger relatives, although the largest trees in the tallest forest were preferred as nest sites. Suitable habitat is fragmented and shrinking within its range and the species is also hunted. The world population has not been estimated, but it is believed to be substantial although slowly declining; this species is not yet considered threatened with global extinction.



White-thighed Hornbill; female, Central African Republic.
Werner Suter



White-thighed Hornbill; male calling, Cameroon.
Gabi Bujanowicz



White-thighed Hornbill; male feeding, Cameroon.
Gabi Bujanowicz



SPECIES ACCOUNTS ASIA

ASIAN HORNBILL RANGE COUNTRIES

	Bangladesh	Bhutan	Brunei	Cambodia	China	India	Indonesia	Laos	Malaysia	Myanmar	Nepal	Pakistan	Papua New Guinea	Philippines	Singapore	Solomon Islands	Sri Lanka	Thailand	Vietnam	Total for species
White-crowned Hornbill <i>Berenicornis comatus</i>			1			1	1	1	1									1		5
Helmeted Hornbill <i>Rhinoplax vigil</i>			1			1	1	1	1									1		5
Rufous Hornbill <i>Buceros hydrocorax</i>													1							1
Rhinoceros Hornbill <i>Buceros rhinoceros</i>			1			1	1	1	1									1		4
Great Hornbill <i>Buceros bicornis</i>	1	1		1	1	1	1	1	1	1	1							1	1	12
Black Hornbill <i>Anthracoceros malayanus</i>			1			1	1		1									1		4
Oriental Pied Hornbill <i>Anthracoceros albirostris</i>	1	1	1	1	1	1	1	1	1	1	1				1			1	1	14
Malabar Pied Hornbill <i>Anthracoceros coronatus</i>						1											1			2
Palawan Hornbill <i>Anthracoceros marchei</i>														1						1
Sulu Hornbill <i>Anthracoceros montani</i>														1						1
Indian Grey Hornbill <i>Ocyrceros birostris</i>	1					1				1	1									4
Malabar Grey Hornbill <i>Ocyrceros griseus</i>						1														1
Sri Lankan Grey Hornbill <i>Ocyrceros gingalensis</i>																1				1
Bushy-crested Hornbill <i>Anorrhinus galeritus</i>			1			1	1	1										1		5
White-throated Brown Hornbill <i>Ptilolaemus austeni</i>				1	1	1		1	1									1	1	7
Tickell's Brown Hornbill <i>Ptilolaemus tickelli</i>										1								1		2
Rufous-necked Hornbill <i>Aceros nipalensis</i>	1	1			1	1		1	1									1	1	8
Knobbed Hornbill <i>Rhyticeros cassidix</i>						1														1
Plain-pouched Hornbill <i>Rhyticeros subruficollis</i>									1	1								1		3
Papuan Hornbill <i>Rhyticeros plicatus</i>						1							1			1				3
Wreathed Hornbill <i>Rhyticeros undulatus</i>	1	1	1	1	1	1	1	1	1	1								1	1	12
Sumba Hornbill <i>Rhyticeros everetti</i>						1														1
Narcondam Hornbill <i>Rhyticeros narcondami</i>						1														1
Wrinkled Hornbill <i>Rhyticeros corrugatus</i>			1			1		1										1		4
Rufous-headed Hornbill <i>Rhyticeros waldeni</i>														1						1
Writhed Hornbill <i>Rhyticeros leucocephalus</i>														1						1
Sulawesi Tarictic Hornbill <i>Penelopides exarhatus</i>						1														1
Luzon Tarictic Hornbill <i>Penelopides manillae</i>														1						1
Mindoro Tarictic Hornbill <i>Penelopides mindorensis</i>														1						1
Visayan Tarictic Hornbill <i>Penelopides panini</i>														1						1
Samar Tarictic Hornbill <i>Penelopides samarensis</i>														1						1
Mindanao Tarictic Hornbill <i>Penelopides affinis</i>														1						1
Total for country (Endemic species)	5	4	8	4	5	9	13	5	10	10	3	1	1	10	1	1	2	13	5	
						(2)	(3)							(10)			(1)			

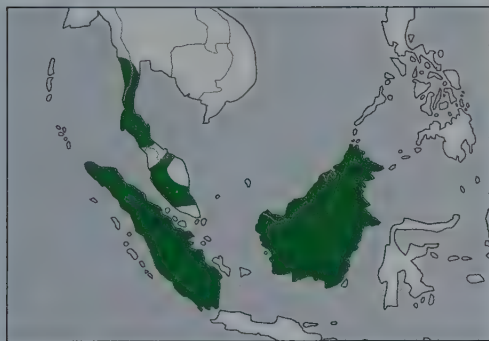
Facing page: Malabar Pied Hornbill, Sri Lanka. Chandrasri Narampanawa

WHITE-CROWNED HORNBILL

Berenicornis comatus (*Buceros comatus* Raffles, 1822)

Taxonomy: Monotypic. Originally thought by some to be closely related to White-crested Hornbill of West Africa, which is then placed in this genus. Until recently placed alone in the subgenus *Berenicornis* within the genus *Aceros*, as it shares distinct all-black adult female plumage with Rufous-necked Hornbill. It is now considered unique in its own genus, as plumage, behaviour and voice are all markedly distinct.

Distribution: Sunda subregion; south Myanmar, south Thailand, Peninsular Malaysia plus Borneo and Sumatra, Indonesia; formerly recorded from central Annam (Vietnam). Reports of records from SW Cambodia during the 1990s turned out to be erroneous (Setha, 2004).



Description: 80-100 cm. Young male 1250-1360 g; female 1470 g. Large hornbill with white spiky crest and white graduated tail, wings with white trailing edge. Male has white neck and underparts, blue bare skin around eye and throat; black bill has small casque. The female is smaller with all-black body except for the white crest. Juveniles of both sexes have white underparts, head and neck, similar to adult male, but with grey streaks on head and breast and dull greenish-yellow bill, proximal half of tail is black and the rest white. The call is a characteristic



White-crowned Hornbill; female, Borneo. Chien Lee

series of mellow double and triple cooing notes, falling in pitch: *ho-ho ho-hoo-hoo*.

Ecology and habits: Found in large expanses of primary rainforest; extends into adjacent closed secondary forest and riverine areas, also recorded in nearby cultivation. Mainly in the lowlands, up to 900 m elevation, recorded to 1,680 m. It is a shy and unobtrusive bird that stays hidden inside the canopy of large trees. It rarely flies high above the forest; instead it flips from tree to tree on short flights at canopy level. The diet has a large proportion of animal food; it actively hunts in the trees, probing the bark and vines for prey and even drops down to the ground regularly. The prey is insects, snakes, lizards and small bird's chicks and eggs, mice. It also takes fruits, mainly lipid-rich drupes and capsules, also some figs. In southern

Thailand fruit food, other than figs, includes *Oncosperma horridum* (Arecaceae), *Litsea* spp (Lauraceae), *Aglaia spectabilis*, *Chisocheton ceramicus* (Meliaceae), *Horsfieldia tomentosa* and *Myristica elliptica* (Myristicaceae) and *Sterculia* sp (Sterculiaceae). It is apparently sedentary and territorial, but somewhat social with co-operative activities reported during breeding. Surveys found that the home range is small, only some 1-10 km².

Breeding ecology: The nesting season is largely aseasonal; egg-laying has been recorded in Jan, Mar, Jun, Oct and Dec. In southern Thailand, nesting season begins in May and finishes in Aug; nests of this hornbill are 5-22 m (average 11 m) above the ground, mostly in tall trees of Dipterocarpaceae (*Hopea*, *Shorea*)

Facing page: White-crowned Hornbill; male with food, Thailand. Morten Strange





WHITE-CROWNED HORNBILL



White-crowned Hornbill; male at nest. Thailand Hornbill Project

and *Syzygium* sp (Myrtaceae). Most nests are found near streams. Co-operative during the nesting period, 3-8 birds may gather around a nesting site. The dominant female chases off other females and enters the nest where she lays probably 2 eggs. One or more males and helpers will bring food to the nest. In southern Thailand, at least ten breeding pairs had only one helper, usually female. Otherwise not much is known about the nesting practice; incubation and nestling periods are not known, but in southern Thailand the nesting cycle is 103-113 days (average 105 days) and 1-2 chicks fledge.

Status: This hornbill has a patchy distribution. It is rare in Thailand and in Peninsular Malaysia and uncommon throughout its range. It occurs in most major protected Sunda subregion rainforest reserves and national parks, such as Hala-Bala Forest Complex in southern Thailand, Taman Negara NP in Malaysia, Gunung Leuser and Way Kampas NP in Sumatra, and the Kinabatangan Wildlife Sanctuary in Borneo. However, suitable habitat is shrinking due to logging activities, conversion to cultivation, forest fires and general development throughout South-east Asia. During a national survey of hornbill populations in Thailand, abundance indices from an average of 145 km line transects (42-293 km in five forest complexes of its range) were 0.03-1.0 bird per km in four forest complexes. In Brunei, abundance indices from line transect surveys of 2-17 km from six localities (every five years during 1991-2001) were 0.2 bird per km from only one locality. Otherwise the world population has not been estimated, but it is believed to be declining. In view of this, the species is classified as Near Threatened with global extinction. CITES Appendix II.



Observations from Thailand have found maximum two helpers around the nest; one female (above) often stays around to help with the feeding of the female that enters the nest.
Thailand Hornbill Project



White-crowned Hornbill; male at nest.
Thailand Hornbill Project



White-crowned Hornbill; male and newly fledged juvenile. Thailand Hornbill Project

HELMETED HORNBILL

Rhinoplax vigil (*Buceros vigil* R. Forster, 1781)

Taxonomy: Monotypic. Placed in a genus of its own due to unique morphology and vocalisation, but a sister species to *Buceros* hornbills and has also been included in that genus.

Distribution: Sunda subregion; south Myanmar, south Thailand, Peninsular Malaysia and Borneo plus Sumatra. Absent from Java and smaller offshore islands; a historical record from Singapore doubtful.



Description: 110–127 cm. Male 3060 g; female 2610–2840 g. Very large hornbill with characteristic elongated central tail feathers of extra 30–45 cm; wings with creamy-white trailing edge. The relatively short bill and front of a high red casque are cosmetically stained with yellow from preen oil. Male has bare red neck. The heavy anterior casque is solid 'ivory'. The female is smaller with pale bluish skin on neck and smaller casque. Juvenile has shorter tail, small yellow bill with low casque and light greenish-blue head and neck. The voice of the male is a unique call that can be heard over 2 km away; it is one of the distinguishing sounds of undisturbed Sundaic rainforest. The male positions himself high in the forest; the call starts as a series of slow deep honking notes, in the beginning far apart; then the notes build up gradually in speed, before climaxing in loud



Helmeted Hornbill; male. Thailand Hornbill Project



Helmeted Hornbill; female. Wong Tsu Shi



Helmeted Hornbill; male, Borneo. Nigel Voaden

maniacal laughter. Bouts of penetrating calls like this, with a few minutes interval, can last for one hour; the female will sometime join in in a duet, her pitch a bit higher.

Ecology and habits: Found in large expanses of primary Sundaic rainforest; extends into adjacent closed secondary forest. Seemingly prefers hilly terrain away from the coast, often at 300–1,100 m elevation, occasionally to 1,500 m. It is shy and wary and rarely comes to the forest edges, preferring remote and rugged terrain. The food is mainly fruits, especially many fig species. In southern Thailand, besides figs, other dominant fruits recorded are in families Annonaceae (*Polyalthia*), Meliaceae (*Aglaia*, *Dysoxylum*), Arecaceae (*Oncosperma horridum*), Lauraceae (*Litsea*) and Myristicaceae (*Horsfieldia* and *Myristica*). Throughout its range, this is the hornbill with the most specialised diet; surveys in both Borneo, Sumatra and southern Thailand have never been able to identify more than 6–7 different fruit tree species as food, compared to a minimum of 16 (Wrinkled Hornbill) and maximum 93 (Bushy-crested Hornbill), for other sympatric hornbills. Surveys of Helmeted Hornbill have shown that it spends about half the day actively hunting animal prey, including rodents,



Helmeted Hornbill; male with prey. Tim Laman

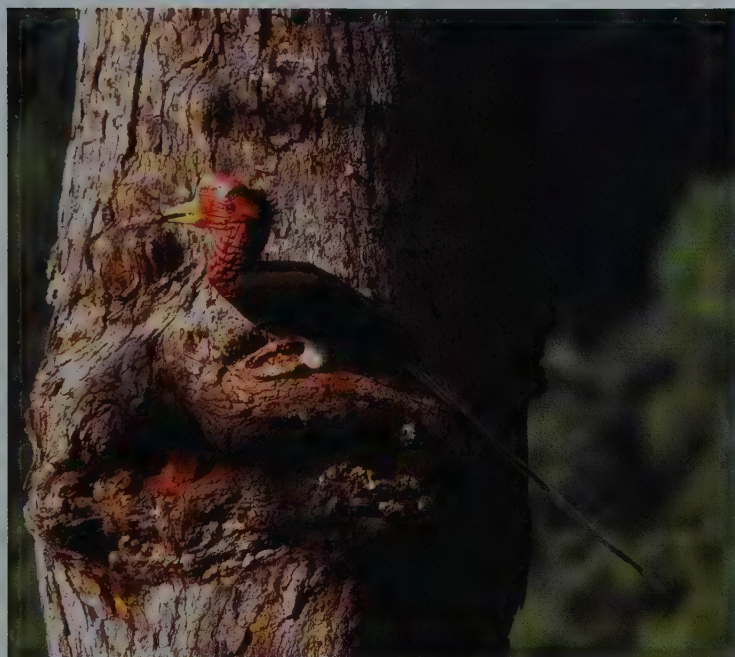
reptiles and nestlings, even smaller sympatric hornbill species. It moves about high in large forest trees and is surprisingly quick and agile when chasing down prey; probes into bark and cavities with its short, strong bill. It is a bit of a loner, and even a pair will split up and feed separately within their home range. Largely territorial and sedentary; males and females have been observed banging the solid casques together, often in flight presumably in status or territorial disputes. Aerial jousting is not

uncommon but jousting to death is rare. It will fly far across the forest to visit good fruiting trees and will mix with other hornbills while feeding; outside of the breeding season up to 27 birds have been reported together. Local villagers regard the trespassing of this bird as an omen of good crop production.

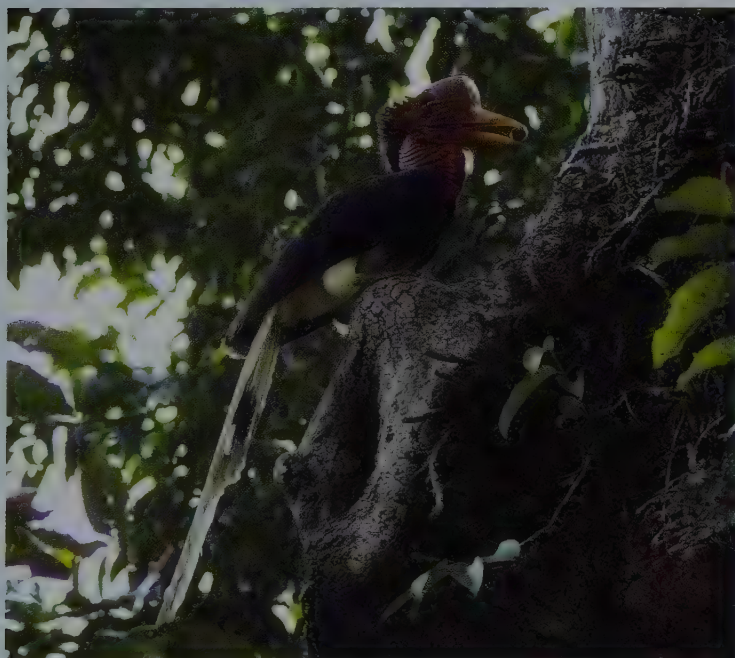
Breeding ecology: The nesting season is largely aseasonal; egg-laying has been recorded in Jan-Mar, May and Nov; on Sumatra nesting

starts from Jan to Aug and from Nov to Mar. In southern Thailand, 87% of nests are found in trees of Dipterocarpaceae, including *Hopea*, *Shorea* and *Neobalanocarpus*. Average of tree size (DBH), tree height and nest height above the ground are 160 cm, 42 m and 30 m, respectively; female seals in Mar and a chick fledges in July. The nest is a natural cavity in a big tree deep inside the forest, in particular the cavity is very characteristic with a ledge above on which the male can land and perch with

HELMETED HORNBILL



Helmeted Hornbill; male at nest. Thailand Hornbill Project



Helmeted Hornbill; male at nest. Morten Strange



Helmeted Hornbill; male at nest. Notice how all the nests show the specific character for this species, with either a protruded or platform structure. Thailand Hornbill Project

its relatively heavy head and short legs while it feeds the female and chick. One nest in Peninsular Malaysia at 800 m elevation was 30 m off the ground. The female seals the nesting hole with mud and food pulp brought in by the male; the floor is lined with wood chips; in one Malaysian survey the sealing lasted 13–14 days, the female staying confined inside the nest after 9 days of work on this. The clutch is 1–2 eggs; the male will feed the female and later a chick inside the nest with regurgitated food and with small animals that it holds in its bill; it will bring 10–113 fruits per visit. Only one chick reported to fledge; exact incubation and nestling period unknown, but suspected to be slightly longer than Great Hornbill. A female was observed in the nest with a chick 146 days after her confinement and is believed to leave the nest with the chick. The average entire nesting cycle is 160 days (range 154–167 days, once 183 days). This species is difficult to keep in captivity, therefore not surprising no success at captive breeding has ever been reported. Since it requires a very specific feature of the nest it is difficult to repopulate once the population has declined.

Status: This hornbill is a low-density species, even in prime habitat. It can still be found regularly within its range where large tracts of virgin forest are available to it, and during surveys it can be located by its unmistakable call. It is present in large rainforest reserves and national parks throughout its range such as Khao Sok– Klong Saeng Forest Complex, Budo Sungai Padi National Park and Hala-Bala Wildlife Sanctuary in southern Thailand, Taman Negara in Malaysia, Gunung Leuser and Way Kampas NP in Sumatra, and Danum Valley Conservation Area and Gunung Mulu NP in Borneo. Outside of protected areas, however, habitat is shrinking due to logging activities and development. The species is



Helmeted Hornbill; male feeding in fruiting tree.
Thailand Hornbill Project

also hunted, mainly for its solid casque and long tail feathers that are traded and used for decoration, with demand in north Borneo at least exceeding supply. National survey of hornbill populations in Thailand during 2004–2008 abundance index from an average of 145 km line transect (42–293 km in five forest complexes of its range) was low (0.01–0.7 bird per km) in five forest complexes. However, 19 nests are known within Budo Sungai Padi NP (Hala-Bala Forest Complex), but only eight nests survived from recent windstorms. In Brunei, abundance indices from line transect surveys of 2–17 km in six localities (every five years during 1991–2001) were 0.03–0.05 bird per km from two localities. The world population has not been estimated, but it is believed to be undergoing a slow but gradual decline; in view of this, the species is classified as Near Threatened with global extinction. CITES Appendix I.

'Ivory' for handicraft

Both male and female Helmeted Hornbill have a solid 'ivory' casque. The material is used by people living in or around the forests to make decorative handicraft items like these. Such items have been traded with China since at least the Ming Dynasty.



Artifacts made from the solid ivory Helmeted Hornbill casque. Thailand Hornbill Project

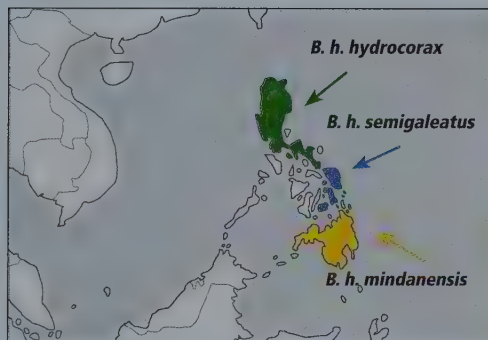
RUFIOUS HORNBILL

Buceros hydrocorax (Linnaeus, 1766)



Taxonomy: Subspecies *mindanensis* and *semigaleatus* rather distinct from *B. h. hydrocorax*, and together they might represent a separate species. Population on Basilan has been proposed as a separate subspecies but they appear inseparable from *mindanensis*. Currently three subspecies are recognised: *B. h. hydrocorax* occurs in northern Philippines in Luzon and Marinduque; *B. h. semigaleatus* occurs in central Philippines in Samar, Leyte, Bohol, Calicoan, Buad, Panaon and Biliran, and *B. h. mindanensis* in the south in Mindanao, Dinagat, Siargao, Balut, Bucas, Talicud and Basilan.

Distribution: Endemic to the Philippines, where it occurs on larger islands throughout the archipelago.



Description: 100 cm. Male 1345–1824 g; female 1171–1662 g. Large hornbill with dark rufous head and neck; bill red with black base extending into face. Sexes similarly coloured, with black underparts, brown back and wings, all-white tail. Female is smaller than male, casque is smaller as well, orbital skin yellow, iris red, although details uncertain. Juvenile is mainly creamy, with grey-brown wings, a black band across the lateral tail feathers, and a smaller casqueless black bill. The subspecies *B. h. semigaleatus* and *B. h. mindanensis* are smaller than nominate race; bill and casque also smaller (especially so in *semigaleatus* with

abrupt taper into sharp point in front); front half of bill yellow. The male *semigaleatus* has orbital skin black and iris yellow, female has orbital skin greenish yellow and iris blue; while *mindanensis* is even smaller than *semigaleatus*, and has red casque, basal half of upper mandible red with corrugation, lower mandible less red but anterior part of the bill is yellowish white. Iris varies from yellowish grey, blue grey to pale green, orbital skin black. This species overlaps with Writhed Hornbill on Mindanao, but can be easily recognised by large orange head. The call is a clear resonant repeated *honk*, the female's call at a higher pitch.

Ecology and habits: Found in large expanses of primary rainforest; extends into mature secondary forest, from the lowlands into the mountains at 2,100 m elevation. It feeds mainly on fruits and seeds, including figs. Also takes animal food, insects and centipedes have been recorded. Usually forages in the canopy of large trees, also occasionally lower and has been reported dropping to the ground. It is believed to be largely sedentary and less mobile than its congeners, Great Hornbill and Rhinoceros Hornbill, and it has shorter narrower wings and shorter red-brown legs. Moves in small groups, on Mindanao it might



Rufous Hornbill; nominate race, female, Luzon. Chris Johns



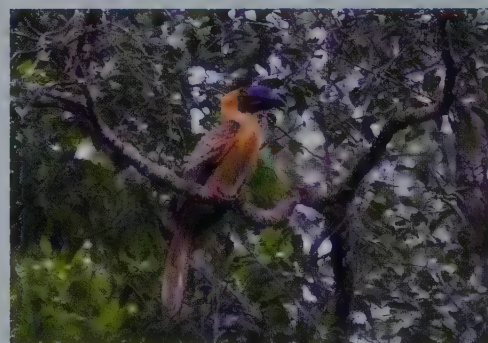
From left: Rufous Hornbill; *B. h. mindanensis*, adult male, immature and adult pair, Mindanao. Lim Kim Chuah

mix with Writhed Hornbill in fruiting trees and at roosting sites.

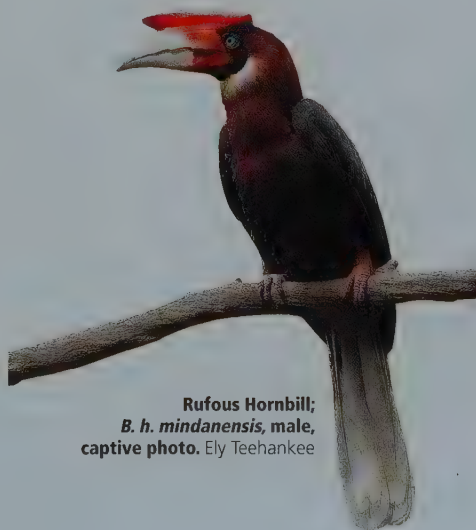
Breeding ecology: Little known, there are two observations from the island of Mindanao. The two nests were in a natural cavity in the trunk of a large tree at 14–30 m above the ground, one in a rotten tree of unidentified species, the other in a huge live dipterocarp tree. Has been reported as co-operative during the nesting period with 3–7 birds, both adults and immatures, helping at chasing off other hornbills from nesting site. Breeding season seems to be aseasonal as copulation is observed in Aug, 2–4 eggs are laid during Jan–May and fledging is reported in Sep. All group members help out feeding the female and chicks inside the nest; the female appears to break out of the nest before the chicks and then helps out with the feeding; but there is no information available on incubation and fledging periods.

Status: A widespread but low-density species dependant on mature forest; this habitat has been cleared rapidly throughout its range. It is estimated that over 70% of forest cover has been lost on the two largest islands, Luzon

and Mindanao, and much more on the smaller islands. Forest is continuously converted to cultivation and human settlements and the species is also hunted for food, for the pet trade and for ornamental use of its casque and feathers. This hornbill is present in protected areas such as Quezon NP on Luzon and Mount Apo NP on Mindanao. The world population has not been estimated, but it is believed to be steadily declining, and the species is classified as Near Threatened with extinction. CITES Appendix II.



Rufous Hornbill; *B. h. mindanensis*, juvenile, Mindanao. Nilo Arribas



Rufous Hornbill;
B. h. mindanensis, male,
captive photo. Ely Teehankee



Rufous Hornbill;
nominate race, male,
Luzon. Nicky Icarangal

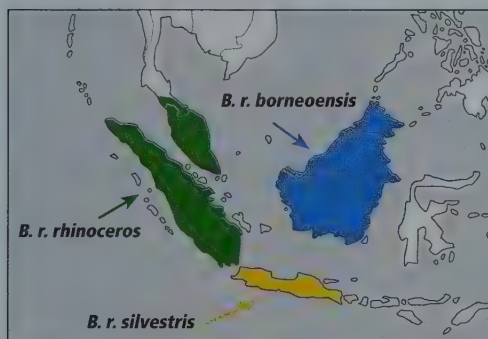
RHINOCEROS HORNBILL

Buceros rhinoceros (Linnaeus, 1758)

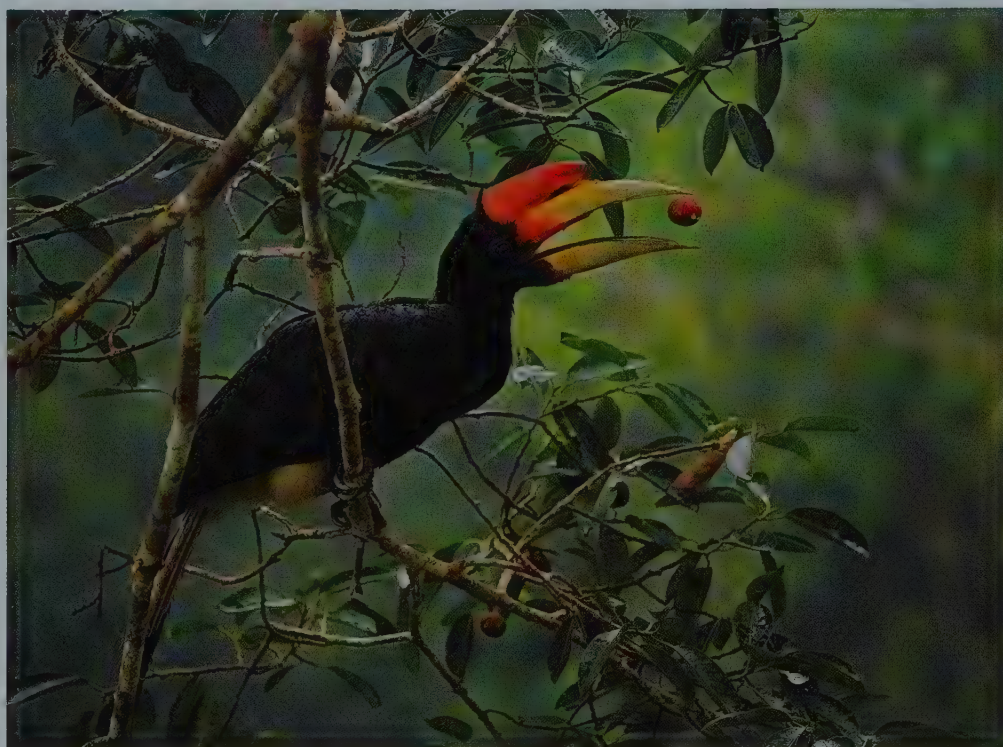


Taxonomy: Forms a superspecies with Great Hornbill, hybridisation has been reported both in the wild and in captivity. On basis of larger size, birds from Sumatra have been suggested as a subspecies, *B. r. sumatranus*, but appear inseparable from nominate. Currently three subspecies are recognised: *B. r. rhinoceros* occurs in south Thailand, Peninsular Malaysia and Sumatra; *B. r. borneoensis* occurs in Borneo, and *B. r. silvestris* in Java.

Distribution: Sunda subregion; south Thailand, Peninsular Malaysia, Borneo, including Brunei and western Indonesia; locally extinct in Singapore.



Description: 99–125 cm. Male 2465–3000 g; female 2040–2330 g. Very large hornbill with black plumage except for white thighs and vent; tail white with broad black band. Male has large ivory-white bill with some bright orange at the base of upper mandible and yellow colouring from preen oil extended to about one third of the bill; the casque is the typical 'horn bill', with prominent reddish orange horn-like shape and black thick line along the rear edge, but thinner along both sides and curved to front. Eyes are red with black orbital skin. Female is smaller with a smaller casque, without black line on it; white eyes and red orbital skin. Borneo subspecies



Rhinoceros Hornbill; *B. r. borneoensis*; immature male feeding on fig. Tim Laman

is generally smaller with shorter, broader casque sharply upturned and curled at tip; Javan subspecies has broader black tail band and forward-pointing straight casque, but with some individual variation. Juvenile has smaller casqueless bill. The call in flight is a characteristic penetrating disyllabic *ger-runk* that can be heard over several km, often as a duet. The male's call near the nest is a regular deep *ho-ok* note, answered by the female's similar, slightly higher and softer note. Wings give out a loud whooshing sound in flight.

Ecology and habits: Found in extensive tracks of primary Sundaic rainforest; extends into mature secondary forest, and occasionally seen flying over disturbed areas or plantations to and from feeding grounds. From sea level

and coastal swamp forest into lower montane forest, recorded to 1,400 m elevation. Feeds mainly on fruits, especially many figs, but also lipid-rich capsules and drupes. In a tropical rainforest of southern Thailand, among non-fig fruit *Polyalthia* sp (Annonaceae), *Aglaia spectabilis* (Meliaceae) and *Oncosperma horridum* (Arecaceae) are dominant. Also takes animal food on an opportunistic basis, often below the canopy, and especially during the breeding season to feed protein to the young. Prey includes invertebrate animals as well as lizards, rodents, tree frogs and bird eggs. In a survey from southern Thailand published in 2011 it was found that of food per weight brought to the nest, 72% was figs, 24% other fruits and 4% animal prey, with 63 g/obs.hr delivered to nests. It is largely sedentary and usually seen in pairs or



Rhinoceros Hornbill; *B. r. borneoensis*, pair, male above, Borneo.
Con Foley



Rhinoceros Hornbill; nominate race, adult female leaving nest. Thailand Hornbill Project



Rhinoceros Hornbill; nominate race, male at nest. Thailand Hornbill Project

RHINOCEROS HORNBILL

small family groups feeding high in the canopy of large forest trees; outside of the breeding season it may travel in search of fruiting trees, particularly figs, and flocks of up to 25 birds, often mainly immatures, might form.

Breeding ecology: The nesting season in the equatorial belt is largely aseasonal; egg-laying has been recorded in Jan, Mar–Jun, Sep and Nov. In southern Thailand, female seals her nest in Mar and a chick fledges in Jul. The nest is a natural cavity 6–46 m (average 22 m) up in large and tall forest trees mainly of Dipterocarpaceae (42% of total 56 nest trees), particularly *Hopea* and *Shorea* spp; probably rarely nests in limestone cliffs. The female will seal the nesting hole until only a narrow elongated slit remains, through which the male will feed her and later the chick. The male will regurgitate fruits from its gullet; it carries animal prey into the nest in the tip of its bill. 1–2 eggs are laid; the incubation period

is 37–46 days. The female will emerge from the nest 39–51 days after the chick hatches; the nestling period is 52–90 days. Total nesting cycle in southern Thailand is 122 days plus/minus 10 days, even longer than for sympatric populations of Great Hornbill.

Status: This hornbill is widespread but occurs in medium to low densities, even in prime habitat. Found in most lowland rainforest reserves and national parks throughout its range such as Hala-Bala WS and Budo Sungai Padi NP in Thailand, Taman Negara NP in Peninsular Malaysia, Gunung Leuser NP and Way Kampas in Sumatra, and Danum Valley, Gunong Mulu and Tanjung Puting NPs in Borneo. The subspecies *B. r. silvestris* is still extant on the heavily populated island of Java, it has recently (2012) been sighted in Ujung Kulon and Baluran NPs, and it is probably also present in other protected areas such as Meru Betiri NP. Outside of protected

areas, however, habitat is shrinking due to commercial and illegal logging activities and conversion to cultivation, especially palm oil plantations. During a national survey of hornbill populations in Thailand during 2004–2008, density was 11 birds per km² in rainforest of Budo Sungai Padi NP, while abundance indices from an average of 168 km line transects (165–170 km in other two forest complexes of its range) was 0.01–1.9 bird per km. In Brunei, abundance indices from line transect surveys of 2–17 km in six localities (every five years during 1991–2001) were 0.1–1.7 birds per km from four localities. The species is also hunted for food and for the pet trade; on Borneo local tribes collect it for the casque and the feathers used in traditional culture, with current demand exceeding supply. The world population has not been estimated, but it is believed to be steadily declining, and the species is classified as Near Threatened with global extinction. CITES Appendix II.



Rhinoceros Hornbill; nominate race, male in flight. Tim Laman



Rhinoceros Hornbill; *B. r. silvestris*, male at nest, Baluran NP, Java. Swiss Winnasis

Facing page: Rhinoceros Hornbill; nominate race, male at a nest inside *Neobalanocarpus heimii* tree, Thailand. Morten Strange

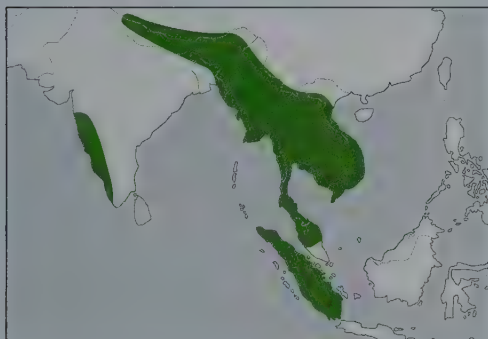


GREAT HORNBILL

Buceros bicornis (Linnaeus, 1758)

Taxonomy: Monotypic. Forms a superspecies with Rhinoceros Hornbill, hybridisation has been reported both in the wild and in captivity. On basis of larger size, birds from Asian mainland have been suggested as a subspecies, *B. b. homrai*. Isolated population in south-west India has been suggested as subspecies *B. b. cavatus*, but it may be inseparable from birds in the rest of the subcontinent.

Distribution: South-west India; south Himalayas and south China into Indochina south to Peninsular Malaysia and Sumatra.



Description: Male 121–150 cm, female 112–125 cm. Male 2610–3900 g; female 2157–3350 g. Very large hornbill with black band across white tail, black wings with white trailing edge. White plumage areas on head, neck, wing coverts and base of tail usually cosmetically stained yellow with green oil. Male has black-rimmed red eyes and flat casque, forked at front with black edges. Female has white eyes with red rim that flushes brighter while breeding and smaller casque without black lines. Juvenile has blue-grey eyes; the small casqueless bill grows to maturity over five years. The voice is a loud and reverberating *kok*, often as a pair duet, that can be heard over 800 meters in the forest, along with other guttural sounds.



Great Hornbill; male in flight. The self-stained yellow tinge on wings and nape shows well here. Tim Laman

Ecology and habits: Found in primary evergreen and moist deciduous forests. Occurs at sea level, but prefers hills further inland between 600 and 1,000 m elevation, in the Himalayan foothills and northern Thailand recorded to 2,000 m. Feeds in the canopy of large trees, often a resident pair or a family group together. Although largely sedentary, it ranges somewhat for food outside of breeding season. Flocks might congregate in fruiting trees or at communal evening roosts – up to 200 have been reported together on one occasion before 1927. Occasionally descends to the ground to pick up fallen fruits. Roams widely in search of fruiting trees, sometimes crossing high over open areas. It flies with heavy wing-beats, 3–4 flaps and a long glide; the massive wings produce

a loud whooshing sound. In Khao Yai NP food eaten and delivered to the nest is mainly fruit, especially many different kinds of figs but also lipid-rich fruits such as those of the Meliaceae (*Aglaia*, *Dysoxylum*, *Chisocheton* spp). However, *Polyalthia viridis* (Annonaceae) and *Cinnamomum subavenum* (Lauraceae) and *Horsfieldia glabra* (Myristicaceae) appear to be high among non-fig fruit items. Flowers and buds are also taken, as well as many animals such as small mammals, birds and reptiles, as well as large insects and other arthropods. When hunting, this hornbill hops along the branches and pokes into crevices and bark for prey, grabbing it with its huge bill and tossing it in the air for a better grip, before flying off to deliver it to the nest. A survey in Khao Yai NP in Thailand found that the diet by weight



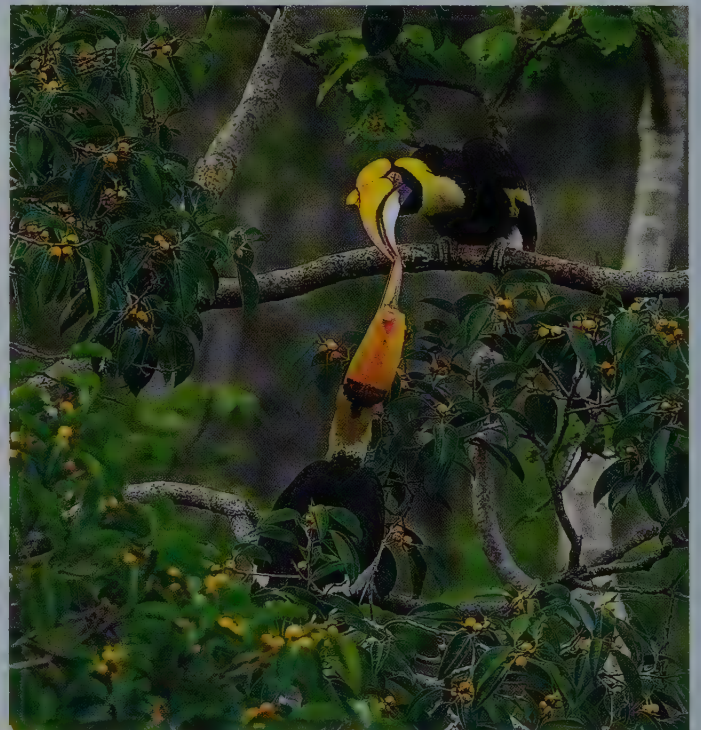


The nesting ecology for the Great Hornbill requires a lot of effort from the adult male delivering food, as the total nesting cycle lasts 3-4 months. Thailand Hornbill Project, Morten Strange



Great Hornbill; female leaves the nest before the chick and helps with the feeding. Morten Strange, Thailand Hornbill Project

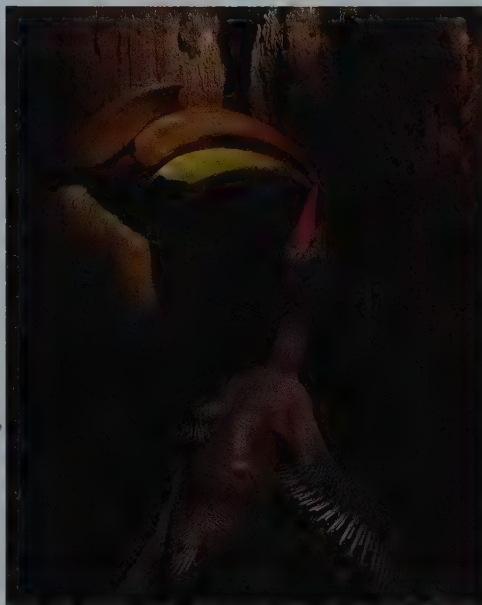
GREAT HORNBILL



The Great Hornbill is territorial and monogamous; the pair bonds with feeding behaviour before the female enters the nesting cavity. Narong Suwannarong

during breeding was 57% figs, 29% other fruits and 14% animal food with 30.5 g per observation-hour; a later survey in southern Thailand found a 54:41:5 ratio with 47 g per observation-hour brought to the nest; while in India, figs of three species predominated throughout the year. Generally, in the non-breeding season there are fewer lipid-rich fruits available, and it relies even more on figs.

Breeding ecology: The nesting season runs from January to June throughout its range, and this species is territorial and monogamous. During breeding, the birds become very vocal, communicating with loud slow calls *kok .. kok...kok*; more rarely, aerial casque-butting has been recorded. The nest is in a very large, live hardwood tree, and predominant trees used are *Dipterocarpus gracilis* and *Cleistocalyx nervosum* (Myrtaceae) in moist evergreen forest of Khao Yai NP, *Shorea faguettiana*, *Hopea odorata*, *Neobalanocarpus heimii* (Dipterocarpaceae) and *Syzygium* (Myrtaceae) in tropical rainforest in southern Thailand, and *Tetrameles nudiflora* (Datisceae) in mixed deciduous forest and *Dipterocarpus turbinata* and *Cleistocalyx nervosum* in hill evergreen forest of Huai Kha Khaeng WS. A hole in a limestone cliff has also been used. The cavity is a natural hole in those trees at 6–45 m above the ground depending on forest type. The female enters and seals herself inside, using mainly faeces for plaster material, also some chewed pieces of wood, bark and food debris, but little if any soil. An elongated 20 x 5-cm vertical slit is left open. 1–4, usually 2, eggs are laid at 4–5 days intervals; incubation is 38–40 days. The male brings food at 30 g per hour for the female and her chicks. Usually, 3–5 visits are made per day, starting late morning, with each visit lasting 15–20 minutes; visits with animal food are shorter. Up to 185 items are delivered daily; the male has been known to deliver up to 50 grape-sized fruits in one



Great Hornbill; female feeding young inside nest. Tim Laman

feeding, regurgitating them individually from his gullet. After the chicks hatch, the number of items delivered increases up to five-fold, but not the number of visits. The male forages over a 1.3–4.5 km² forested area around the nest, flying up to 3 km away. The female emerges when the chick is 14–59 days old or 85 days on average (range 62–121 days) after sealing in; after that she helps the male with the feeding. The chick then re-seals the nest entrance and fledges after 72–96 days. Total nesting cycle is between 102–144 days; in captivity it is shorter. Radio tracked breeding male in breeding season in Khao Yai NP, daily movement was 4–14 km which covers 0.7–6 km²; throughout the entire breeding season a male covers about 7 km² on average. A survey from Khao Yai NP, Huai Kha Khaeng WS and southern Thailand found a nesting cycle of 120, 123 and 111 days \pm 7–10 days respectively. After fledging, the chick remains near the nest, a radio-tracked chick remaining within 2 km for several

months. The chick is depending on the parents for food until it is up to 6 months old and the casque begins to form. The tight bond between the pair, and the long and complex breeding cycle of this species, makes it difficult to breed in captivity, although there have been a few successes. Longevity in captivity recorded to over 41 years and in the wild up to 30 years.

Status: Widespread but generally scarce throughout large range. It is more common in large forest tracts, uncommon in fragmented forests as in Western Ghats, India. Annual home range up to 600 km² currently monitored by GPS satellite telemetry for a family is recorded at Khao Yai NP, although the range of a male at 1.4 km² in a breeding season has been monitored in this area by radio telemetry. In non-breeding season, the home range is 11 km² on average in moist evergreen forest; in mixed deciduous forest it is about 10 km² and in hill evergreen forest it is about 6 km² in western Thailand; in rainforest it is 1–2 km² in southern Thailand. It is rare in China (Yunnan province) and Indonesia (Sumatra only). Population is declining in many areas such as India, Nepal, Cambodia and Indonesia, mainly due to habitat degradation and hunting. Bill used in traditional headdress in northeast India, but the Nishi community is now using artificial bills. During a national survey of the hornbill populations in Thailand during 2004–2008, density was 1.3–4.7 birds per km² in Huai Kha Khaeng, Thungyai Naresuan WS, Khao Yai NP and Budo Sungai Padi NP (Hala-Bala Forest Complex); otherwise abundance indices from an average of 150 km line transects (42–293 km in other 11 forest complexes of its range) were 0.04–1.1 birds per km from nine forest complexes. Bred repeatedly in captivity, but this is not sufficient to satisfy avicultural demand. Near Threatened; CITES Appendix I.

BLACK HORNBILL

Anthracoceros malayanus (*Buceros malayanus* Raffles, 1822)



Taxonomy: Monotypic.

Distribution: Occurs in the Sunda subregion: from south Thailand into Peninsular Malaysia; Sumatra, including offshore islands of Singkep, Bangka and Belitung; Borneo.



Description: 75–80 cm. Male 1050 g. Medium-sized black hornbill; differs from the sympatric Oriental Pied Hornbill by its entirely black underparts and lack of white trailing edge in wings visible during flight. Outer tail feathers tipped white. Most (85%) of individuals have prominent white or pale grey superciliary stripe; the rest (15%) have dark grey hardly visible stripe. Male has ivory bill with large casque and dark orbital skin; female has black bill with small casque and pinkish orbital skin around brown eyes. Juvenile has smaller pale greenish bill without casque. The voice is somewhat crow-like with loud harsh braying notes rising and falling in pitch.

Ecology and habits: Occurs in primary lowland rainforest, usually below 200 m elevation, rarely up to 600 m; frequently near water courses and often seen in alluvial flood plains and swamp forest; extends into mature secondary forest and forest edges nearby. Where it overlaps with Oriental Pied Hornbill it can be found deeper within closed forest. It feeds



Black Hornbill; adult pair, male on left, Borneo. Con Foley

mainly on larger lipid-rich fruits; it takes fewer figs, although 17 varieties have been identified. In a peat swamp forest of southern Thailand, fruit food of *Cryptocarya ferea* (Lauraceae), *Aglaia rubiginosa* (Meliaceae), *Horsfieldia* spp, *Myristica* spp (Myristicaceae) are recorded. Its fruit food recorded from Borneo is similar, *Polyalthia* (Annonaceae), *Aglaia* and *Myristica*. It also takes small animal food items including insects, skinks and bird eggs; it has been observed catching bats emerging from their cave at dusk and then feeding them to juveniles. When in the forest, it feeds inside the canopy, often visiting fruiting trees at dawn. It will use its powerful bill to split husks and tear into bark. It appears to be sedentary and territorial; usually a

pair will be seen together, only rarely in flocks, then mainly of juveniles; up to 33 birds have been recorded together.

Breeding ecology: Not much is known. May not nest every year and timing is aseasonal; egg-laying recorded in Jan–Feb, Apr, Aug and Nov–Dec. In southern Thailand, a chick fledged from the nest in June. Two nests were in a natural cavity at about 10 m above the ground of *Ganua motleyana* (Sapotaceae) trees, with DBH of 41–55 cm, in a peat swamp forest; possibly also in an abandoned woodpecker hole. In captivity, 2–3 eggs were laid; incubation was about 30 days and up to two chicks may be raised. Male feeds female



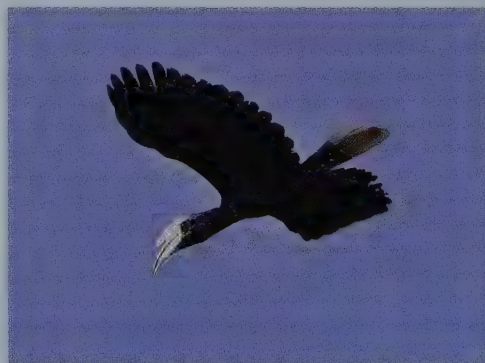
Black Hornbill; male feeding on *Aglaia* fruit. Notice grey superciliary stripe; in many individuals, this stripe is bright white. Tim Laman

and later chicks at the nest; he is mainly quiet during this period. Nestling period is about 50 days; the adults will attend to the chicks for some time after fledging.

Status: Widespread but scarce throughout its range. Can be locally rather common in prime habitat, such as in some protected lowland forest areas of Borneo and Way Kambas NP in Sumatra, but generally uncommon. Surveys have found densities ranging from 0.3–3.3 birds per km². National survey of hornbill population in Thailand during 2004–2008 abundance indices from an average of 170 km line transects (53–293 km in four forest complexes of its range) were extremely low (0.003–0.4 bird per km) in two forest complexes. In the last two decades, only two nests were confirmed in a peat swamp forest of the Hala-Bala Forest Complex. In Brunei, abundance indices from line transect surveys of 2–17 km in six localities (every five years during 1991–2001) were 0.1–1.8 birds per km from five localities. The specific habitat requirements (low, wet, primary rainforest) expose it to disturbance and habitat clearance. Much of its habitat throughout the Sundaic region has been or is being logged commercially or illegally, and converted to human settlements and cultivation such as palm oil plantations. The world population has not been estimated, but is believed to be declining. Therefore it is considered Near Threatened with global extinction. CITES Appendix II.



Black Hornbill; male at nest. This nest was located 19 m a.s.l. in the Sirindhorn Peat Swamp Forest Nature Research and Study Center in Narathiwat province, near the Malaysian border in southern Thailand. The nest was 10 m above the ground in the cavity of a 25 m tall Sapote tree (*Ganua motleyana*); the nest entrance was a vertical slit about 15 x 30 cm. Thailand Hornbill Project



Black Hornbill; male in flight, Borneo. Con Foley

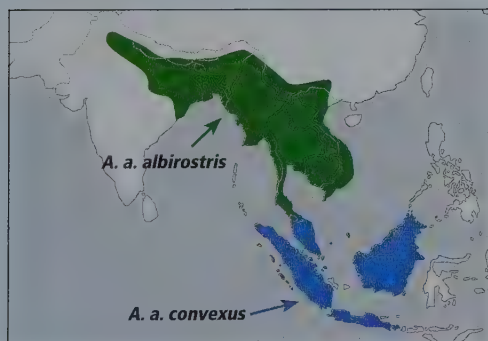
ORIENTAL PIED HORNBILL

Anthracoceros albirostris (*Buceros albirostris* Shaw and Nodder, 1790)



Taxonomy: Forms a superspecies with Malabar Pied Hornbill and Palawan Hornbill. Was previously considered conspecific with Malabar Pied Hornbill but there are significant differences in morphology and ecology, as well as a geographic area of overlap without interbreeding. Two subspecies recognised; *A. a. albirostris* occurs in the Oriental region south to northern Peninsular Malaysia; *A. a. convexus* replaces it here and across the Sunda subregion; it was for a while considered a separate species based on slightly larger size and full white outer tail feathers (*A. a. albirostris* has only outer tip of tail white); however, difference in tail pattern is not constant, and interbreeding in transit-zone (northern Peninsular Malaysia) was never ruled out.

Distribution: Occurs throughout the Oriental region from northern India and south Nepal, south-east Tibet to south Yunnan and south Guangxi, China, across South-east Asia east to Java and Bali as well as many offshore islands within this range. The only hornbill extant in Singapore, where it is well monitored and studied.



Description: Male 70–85, female 60–65 cm. Male 680–907 g; female 500–879 g. Medium-sized hornbill; black with white underparts. White on outer tail tips and trailing wing edges show in flight. The male has a large

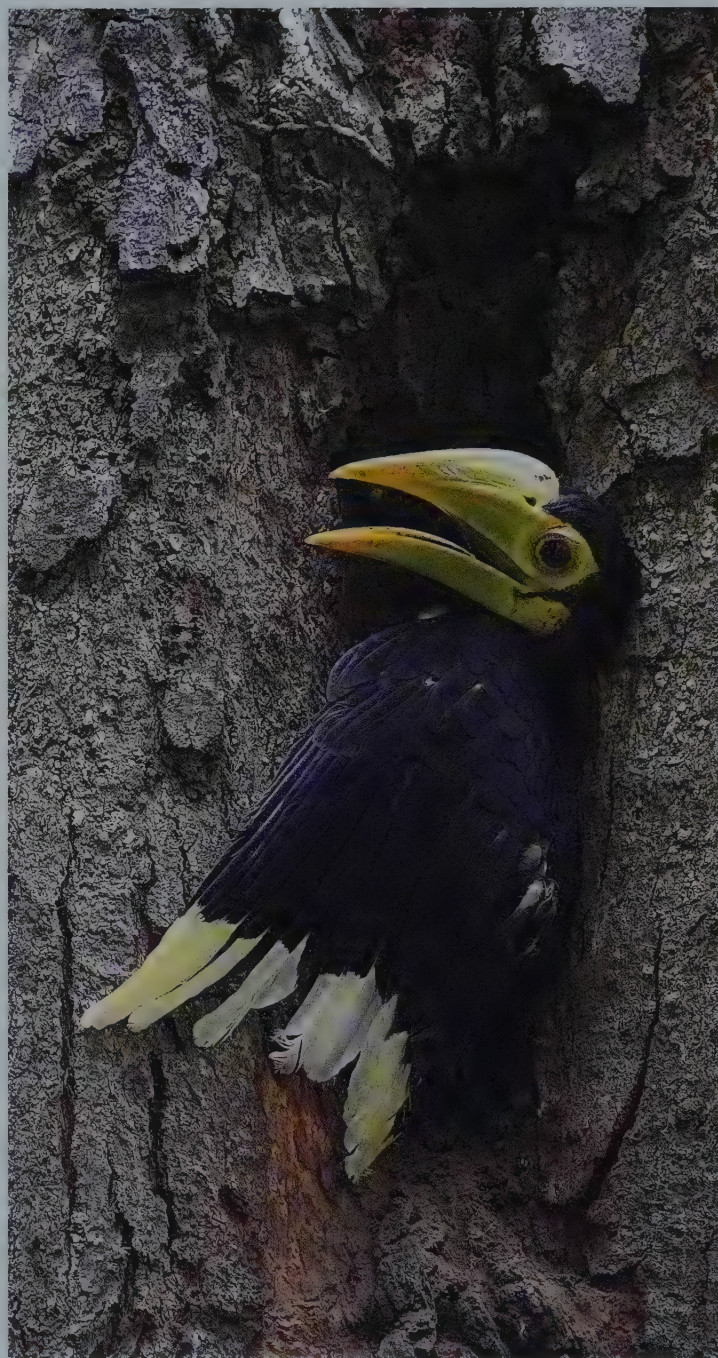


Oriental Pied Hornbill; nominate race, an immature is learning a feeding lesson, Khao Yai NP, Thailand. Morten Strange

creamy bill with large black base on lower mandible; the casque is large, cylindrical with projecting compressed anterior part marked black. The female's bill and casque are smaller, marked with black, and without the anterior blade; lower mandible has dark red spot. Both sexes have pale blue bare skin around eyes and on throat. Juvenile is less glossy black, bill is smaller and pale with undeveloped casque. Vocal, noisy and often located by call; the voice by both sexes is a characteristic variety of squeals and chuckles described as *kleng-keng ... kek-kek-kek-kek*.

Ecology and habits: Apart from maybe the Indian Grey Hornbill, this is the only Asian hornbill that does not depend on primary forest for habitat, not even for breeding. It does occur in closed deciduous or evergreen forest,

but it prefers forest edges, open woodlands and even coastal and riverine scrub and cultivation. Occurs in the coastal lowlands and extends inland up to 700 m elevation. In South-east Asia it can be seen at close range, coming to feeding tables in beach resorts and villages near forested areas where it will feed on papaya, rambutan, mango, banana and other readily available fruits. It feeds mainly on fruits; in Thailand 49 different fruit varieties have been identified with more non-fig (47%) than fig species (33%). Wild fruit of preference other than figs includes *Polyalthia* (Annonaceae), *Horsfieldia* (Myristicaceae), *Strombosia* (Oleaceae) and *Dysoxylum* (Meliaceae). It will also take animal food and a large variety of prey has been identified (56 species) including various insects, centipedes, millipedes, scorpions, spiders, snails, earthworms, lizards,



Oriental Pied Hornbill; nominate race, female enters nest, has a last look out (above), and some three months later, a chick emerges. Narong Suwannarong

ORIENTAL PIED HORNBILL



Oriental Pied Hornbill; *A. a. convexus*, female (top) and male (above), southern Peninsular Malaysia. Notice natural variation in tail colour pattern. Morten Strange

small birds and eggs, and rats; occasionally it even takes snails, crabs and fish from the water's edge. It feeds mainly in the canopies of trees but will also drop to the ground to pick up fallen fruits or prey; it uses its large bill with finesse to grab, tear and swallow small food objects. Moves in pairs or family groups and is largely sedentary and territorial. Outside the breeding season, flocks of up to 170 birds have been recorded in Khao Yai NP; they move around to favorable feeding habitats and fruiting trees. In non-breeding season they may be seen dust-bathing to repel ectoparasites.

Breeding ecology: This species is well studied and documented. The nest is a natural cavity at ground level up to 30 m up in a tree, often *Dipterocarpus* or *Cliostocalyx* species; rarely in a limestone cliff. In Singapore, artificial nesting boxes have been used. Along Kinabatangan River, Sabah, it nests in a cavity of *Nauclea* (Rubiaceae) and *Cratoxylum* (Hypericaceae). The nesting is in territorial pairs; the female does most of the nest preparation and seals herself in after mating, while the male provides her with pieces of earth taken from roots of a fallen tree or dug from the ground. Eggs are laid at various times across the range but typically Feb-Apr on the Asian mainland; Sep-May on many Malaysian and Indonesian islands. The clutch is 1-4 eggs; incubation period is 25-33 days. The male will feed the female and the chicks at the nest with regurgitated food or small prey carried in the bill. The female emerges with the chicks or up to 20 days before the chicks, being confined in the nest for 66-100 days. Nestling period takes 41-64 days. Chicks hatched last may become weaker and be killed by the female or starve, then consumed by a sibling or the female. On average, the entire nesting cycle takes 85-90 days (range 70-107 days) depending on geographical area.

Status: Widespread throughout vast range and locally common in many places such as on islands. Opportunistic and adaptable species, it can feed on ornamental fruit trees and breed in relatively small trees, often near villages and cultivated areas. The pair can also use a household container or even an empty Stupa (a Buddhist worship structure) as a nest chamber. This species also occurs in many protected areas such as Khao Yai NP in Thailand and Taman Negara in Malaysia where it occupies the fringes of the forest. In

Yunnan and Guangxi, China, populations are threatened by extinction due to rapid conversion to cultivation of its habitats. In a national survey of the hornbill populations in Thailand during 2004–2008, density was 21 birds per km² in Khao Yai NP, otherwise abundance indices from an average of 150 km line transects (42–293 km in other 11 forest complexes of its range) were 0.01–0.9 birds per km from eight forest complexes. In Brunei, abundance indices from line transect surveys of 2–17 km in six localities (every five years during 1991–2001) were 0.08–12.5 birds per km from five localities. Although still hunted in some areas for food or for the pet trade, the overall population does not seem to be declining, and it is not considered threatened with extinction. CITES Appendix II.



Oriental Pied Hornbill; nominate subspecies, male at nest in Khao Yai NP in Thailand. Thailand Hornbill Project



The Oriental Pied Hornbill is not exclusively depending on forest to nest; some nest in huge forest trees like this male from Huai Kha Khaeng WS in Thailand (top), but it is just as likely to select a small-girth tree near a rural village, like this pair *A. a. convexus* from Ubin island in Singapore (above) has. Thailand Hornbill Project, Ong Kiem Sian

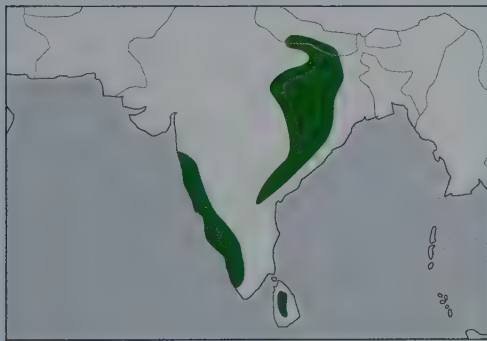
MALABAR PIED HORNBILL

Anthracoceros coronatus (*Buceros coronatus* Boddaert, 1783)



Taxonomy: Monotypic. Forms a superspecies with Oriental Pied Hornbill and Palawan Hornbill. Was previously considered conspecific with Oriental Pied Hornbill but there are significant differences in morphology and ecology, as well as a geographic area of overlap without inter-breeding.

Distribution: Found in the Western Ghats and north-eastern Himalayan foothill regions of India and Nepal, linked via the Satpuda Hills, as well as on Sri Lanka.



Description: 65–92 cm. Female 1000 g. Medium-sized hornbill; black with white underparts, white outer tail feathers and trailing edge to wings visible in flight. Male has large creamy white bill with black base and a huge ivory yellow and black casque with projecting front end; red eye is surrounded by black bare skin. From the Oriental Pied Hornbill where they overlap by bigger size and larger head and casque. The female's bill and casque is smaller than male's (but still bigger than Oriental Pied Hornbill's); the bare skin around eye is pale blue becoming pink when breeding. Juvenile has smaller, casqueless, plain dull-yellow bill. Voice is like Oriental Pied Hornbill's but deeper and more monotonous; also loud whistles upon arrival at roost.



Malabar Pied Hornbill; pair, male on right, in Karnataka state, India. Niranjana Sant

Ecology and habits: Occurs on margins of rainforest and in deciduous woodlands; extends into more open patches of forest and will visit isolated fruiting trees to feed from the lowlands up to 300 m elevation. There it feeds mainly on fruits; in the Western Ghats one fig species (57%) and a *Putranjiva* (Euphobiaceae) are the main source when breeding, but 17 fruit varieties have been identified with the fig (36%) and a *Strychnos* (Loganiaceae) (20%) in the non-breeding season. Also eats some leaves and small animal prey such as insects and lizards

that it captures on an opportunistic basis. Feeds inside the canopies of trees but can also drop to the ground to pick up fallen fruits or animal prey. Mainly sedentary but will make local movements in search of fruiting trees; it will gather in small flocks at good feeding sites or at evening roosts, and as many as 58 birds have been recorded at one site.

Breeding ecology: Breeding season begins during Mar–Apr. The nest is a natural cavity 3.5–15 m up in a tree; in India *Tetrameles*

The Malabar Pied Hornbill is monotypic throughout its large range. There do not appear to be significant differences between populations in Sri Lanka and India.



Malabar Pied Hornbill; female with white orbital skin, Karnataka state, India. Niranjn Sant



Malabar Pied Hornbill; female with pink orbital skin, Sri Lanka. Chien Lee



Malabar Pied Hornbill; adult female, Karnataka state, India. Niranjn Sant

MALABAR PIED HORNBILL



Malabar Pied Hornbill; immature female, Sri Lanka. Gehan de Silva Wijeyeratne



Malabar Pied Hornbill; female, Karnataka state, India. Kalyan Varma



Malabar Pied Hornbill; female, Sri Lanka. Christoph Moning



Malabar Pied Hornbill; male at nest, Karnataka state, India. Niranjana Sant

nudiflora (Datiscaceae) and *Terminalia bellirica* (Combretaceae) have been used. Most nesting attempts are successful. The female seals herself in after mating with little help from the male, using droppings and food pulp; usually eggs are laid during the rainy season, Mar-Sep. The clutch is 2-4 eggs; incubation period is 29-30 days. The male will feed the female and the chicks at the nest with regurgitated food. The female emerges before the chicks when the oldest chick is between 10 and 35 days old; the chicks will stay in the nest a bit longer; the female will help the male feed the chicks; fledging period is 49 days.

Status: Still fairly common in prime habitat with large tracks of moist forest available and low human density. However, has suffered from loss of habitat due to rapid degradation and fragmentation of forests in the last few decades due to logging, slash-and-burn cultivation and excessive gathering of firewood, especially in Sri Lanka and in western India, where hunting by local tribes is also an issue. Astonishingly, for this species Kinnaird & O'Brien (2007) found that out of a huge range area of 851,423 km² only 2,972 km² (less than 1%) was optimal habitat. It is still relatively abundant in five main areas in India, including protected reserves such as Nagarhole NP. In Sri Lanka, where it is one of two hornbill species on the island, it is less widespread than the sympatric Sri Lankan Grey Hornbill and now largely confined to three protected areas: Udawalawe, Yala and Wasgamuwa National Parks. World population has not been estimated, but it appears to be declining due to loss of habitat, and the species is currently considered Near Threatened with global extinction. CITES Appendix II.

PALAWAN HORNBILL

Anthracoceros marchei (Oustalet, 1885)

Taxonomy: Monotypic. Forms a superspecies with Oriental Pied Hornbill and Malabar Pied Hornbill.

Distribution: Endemic to the Philippines; occurs on Palawan and some nearby smaller islands including Balabac and Busuanga, and Calauit and Culion in the Calamian group.



Description: 55 cm. Male 580-920 g. Medium-sized hornbill; all-black except for white tail and blue skin around eye and throat. Male has large creamy bill with black base on lower mandible and a large casque with projected front end. The female is like the male except for smaller bill and casque. Juvenile has even smaller, paler bill with grey base. This is the only hornbill in the Palawan island group, so confusion with other birds not possible. Especially vocal early morning and late evening; the voice is a shrill raucous *caaauw* or more usually *kreek-kreek*.

Ecology and habits: Found in primary and secondary rainforest, also ventures into adjacent mangroves and nearby cultivation to feed, from the lowlands up to 900 m elevation. A vocal bird and conspicuous when it feeds in small groups in the canopy of trees; also moves lower and even drops to the ground. The food is mainly fruits but no detail information as

to fruit species is available; some animal prey such as insects and lizards has been recorded. Probably sedentary within fairly small range.

Breeding ecology: Little known. Male in breeding condition in Apr; one nest recorded 20 m up in a tree but no further information; the female and chicks were sealed inside. No information available on incubation or fledging periods.

Status: Out of the five major islands where it occurs, the three smaller ones are now largely cleared of forest. Kinnaird & O'Brien (2007) found that out of a range area of 12,885 km² only 2,747 km² was optimal habitat. There have been recent observations from about 10 localities, including several tiny offshore islands. On Palawan itself, it is only common in Puerto Princessa Subterranean River National Park in the Saint Paul mountain range and possibly also in the El Nido reserve; most visitors go there to see the bird. It also occurs in the Iwahig penal colony, which has no protection status. There is habitat available on Mount Victoria and Mount Mantalingahan where further surveys are required. In Omoi Cockatoo Reserve on the nearby Dumarang Island as well as in Culasian Managed Resource Protected Area on Rizal, southern Palawan, the Palawan Hornbill also occurs, and here it has benefited locally from a protection scheme originally created for the Philippine Cockatoo. The whole of Palawan is designated as a Biosphere Reserve where hunting and trapping is illegal, but difficult to stop completely; the hornbill is still being hunted for food and for the pet trade. The world population has been estimated to be between 2,500 and 10,000 individuals. Because of its small world range and small and decreasing population, the Palawan Hornbill is considered Vulnerable to global extinction. CITES Appendix II.



Palawan Hornbill; male in a fig tree. Tim Laman



Palawan Hornbill; female feeding on fig. Tim Laman

SULU HORNBILL

Anthracoceros montani (*Buceros montani* Oustalet, 1880)

Taxonomy: Monotypic. Relationship with congeners is uncertain.

Distribution: Endemic to the Philippines; distributed in the Sulu Archipelago on the islands of Jolo and Tawi-Tawi; recently recorded also from Tandubatu, Dundangan and Baliungan.



Description: 50 cm. Medium-sized hornbill; all-black, except for white tail. Male has creamy white iris; female has smaller bill and casque, eye dark brown. Juvenile has smaller casqueless greenish-yellow bill, skin around eyes grey (not black as in adults). This is the only hornbill within its range, so confusion with other birds not possible. The call is a loud mishmash of cackles, clucks and shrieks.

Ecology and habits: Found in rainforest in lowlands as well as highlands. In recent years it has been reported to be typical for montane areas, but this could be because of clearance of lowland habitat more so than habitat preference. It depends on large forest trees for nesting, but has been observed feeding in cultivation and isolated trees over 1 km from nearest forest. It is reported to eat fruits as well as some animal prey, such as insects and small lizards. Probably it is sedentary within small range; it usually moves in pairs.



Sulu Hornbill; suspected female. Robert Hutchinson

Breeding ecology: Little known. It nests in a cavity of large trees; a reported clutch size was 2 eggs; fledglings seen in May-Jun; on Tawi-Tawi, a pair was seen with immature in Sep.

Status: This hornbill was described as common to abundant at the time of its discovery but has since then and especially in the last few decades seen its population crash, and it is now facing imminent extinction. Kinnaird & O'Brien (2007) found that out of a range area of 1,405 km² only 226 km² was optimal habitat. The last record from Jolo (=Sulu Island) is in 1883 and it must now be considered extinct there. Records dating back to 1995 from the small islands of Tandubatu, Dundangan and Baliungan are believed to be of visiting birds; there are no indications of stable breeding populations on these islands. It was formerly on Sanga-sanga Island, but the forest there has now been cleared, and the hornbill is almost certainly extinct as well. In fact, the species occurs with certainty only on Tawi-Tawi. An estimated 250-300 km² of forest habitat remains on that island, especially along the main mountain range, and there are perhaps some 20 breeding pairs left. Persisting habitat clearance for cultivation and some hunting for food and for the pet trade put the

small remaining population under continuous pressure. There are no formal protected nature reserves in the Sulu archipelago, and political instability in the area makes research difficult. Considering this, the Sulu Hornbill is classified as Critically Endangered with global extinction. CITES Appendix II.



Sulu Hornbill; suspected female, Tawi-Tawi. Desmond Allen



Sulu Hornbill; suspected male, Tawi-Tawi. Desmond Allen

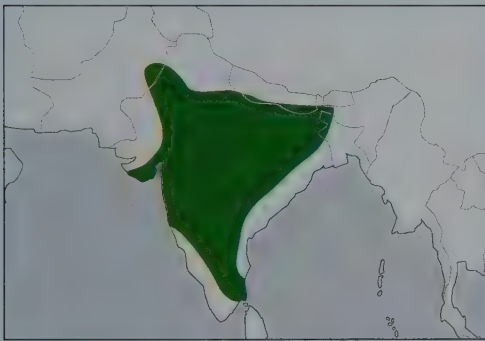
INDIAN GREY HORNBILL

Ocyrceros birostris (*Buceros birostris* Scopoli, 1786)



Taxonomy: Monotypic. Genus in the past combined with African *Tockus* but differs in breeding ecology.

Distribution: Indian subcontinent; found from north-east Pakistan and south Nepal east to north-west Bangladesh and south throughout most of India except in Assam.



Description: 50–61 cm. Male 375 g. Small brownish-grey hornbill; from similar Malabar Grey Hornbill, where they overlap in west of range, best separated by black bill (not yellow without casque); tail long, graduated with black then white tip. Partly sympatric Malabar Pied Hornbill is larger and has distinct pied plumage and much larger white with black patch casque. Male has narrow black casque with pointed front and red-brown eyes with black orbital skin; female is smaller with smaller casque and dark brown eyes with dull red orbital skin. Juvenile like adult, except for being casqueless, smaller and with pale yellow bill, making it easily mistaken as Malabar Grey Hornbill. Vocal and noisy, especially in the early morning; the call is a variety of loud cackling and squealing notes, and some short, piping notes *pi-pi-pi-pi* .. *pipipiew-pipipiew-pipipiew*.

Ecology and habits: Occurs in deciduous forests, open woodlands and thorn forest as well as rural cultivation and urban gardens



Indian Grey Hornbill; adult pair, male on the right, Chamba district, India. Paul Noakes

and parks, especially areas with many fig trees. It is often in the lowland plains up to 600 m elevation, but in the Himalayan foothills it has been reported to 1,400 m. Where it overlaps with Malabar Grey Hornbill, this species is more adaptable and prefers the lower, more open and less wooded areas. The food is mainly fruits, particularly figs, also occasionally flowers; in one survey 22 varieties of fruits were identified. It also takes some animal prey such as insects, small reptiles, rodents and bird nestlings. It is an active feeder that will move frequently from tree to tree; the flight is a characteristic undulating, rapid flapping

interspersed with brief glides with wing-tips upturned. It feeds mainly in the canopies, but can drop to the ground and hop around with raised tail to pick up fallen fruits and the occasional animal prey. It is generally sedentary but will move around locally in search of fruiting trees; often in resident pairs or small groups of 5–6 birds, but flocks of up to 30 individuals have been reported at favourable feeding sites. Dust-bathing is recorded.

Breeding ecology: Not fully understood, this species might be co-operative at times with several male birds helping out at one nest.

Eggs are laid in the beginning of the year in Feb or May-Jun, which is at the end of the dry season. The nest is a cavity in a tree 3-13 m off the ground; native as well as introduced varieties have been used. It has been reported to compete with Rose-ringed Parakeet and Common Myna for nesting holes, with the hornbill dominant, emptying out the parakeet's nest and eating the chicks. The elaborate courtship between the couple starts some 3 months before the female enters the nest and includes inspection and cleaning out of the nesting hole, courtship feeding, bill grappling and pulling each other's tail. The pair will mate many times before the female enters, always in the nesting tree or another large tree within 100 meters of it. Each mating lasts from a few to 106 seconds. The female enters the nest and seals the entrance herself using her droppings and food pulp as a cement; the male will assist by bringing some mud throughout the breeding cycle so that the female can maintain the gap. There is a pre-laying period of about 7-10 days, then a clutch of 2-5 eggs are laid. The incubation period is at least 21 days. The fledging period is at least 45 days, but the female will emerge from the nest about 1-4 weeks before the chicks are ready to leave, making it on average 66 days for the female's incarceration. The chicks will repair the nest after her with mud pellets brought by the male; space in the nest is too tight for her, and the chicks are now ready to feed and clean up the nest themselves. The female now helps with the feeding, but is less active than the male. The chicks will leave one by one a few days apart, the remaining chicks keeping the nest repaired till they are ready to break out themselves. The whole nesting cycle lasts 93 +/- 5 days.

Status: This hornbill is widespread across a huge subcontinent, the range being over 2 million km², and it is still common in many



Indian Grey Hornbill; immature, Karnataka state, India. Kalyan Varma

areas. However, Kinnaird & O'Brien (2007) found that out of a range area that they calculated to be 2,527,772 km² only 146,364 km² (about 6%) was optimal habitat, which tells you something about the ecological state of the Indian subcontinent. But this is an adaptable species that can co-exist with rural human settlements, although habitat degradation along the Western Ghats is reducing available food plants in the drier habitats that it favours. It is even found in urban areas and parks where it can nest in large road-side trees. The global population size has not been quantified but is believed to be substantial and stable; there is currently no evidence of decline, and this species is not globally threatened.



Indian Grey Hornbill; immature male, Bangalore, India. Garima Bhatia

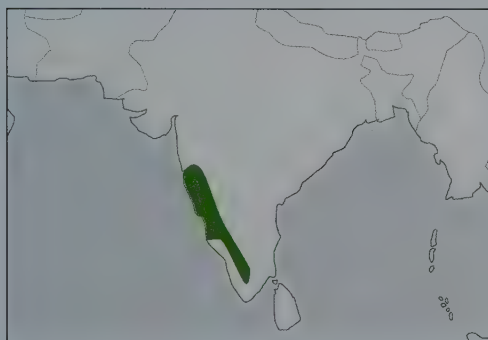
MALABAR GREY HORNBILL

Ocyrceros griseus (*Buceros griseus* Latham, 1790)



Taxonomy: Monotypic. Genus in the past combined with African *Tockus* but differs in breeding ecology. Sometimes considered conspecific with Sri Lankan Grey Hornbill but there are significant differences in bare-part colours, morphology and behaviour.

Distribution: Endemic to India; found in the Western Ghats of the south-west.



Description: 45 cm. Male 238–340 g. Small grey hornbill with rufous vent; from similar Indian Grey Hornbill where they overlap in range best separated by yellow (not black) bill. The sympatric Malabar Pied Hornbill is much larger and has distinct pied plumage and much larger casque. Male has long curved yellow-orange bill, paler at tip, with low casque; female is smaller with smaller dark-spotted casque and black base of lower mandible. Both sexes have a white broad supercilium stripe above the eyes running along the head to the hind neck, whitish streaks on head, crest, throat and upper breast. Juvenile resembles adult female, but with smaller paler bill and no casque. Voice is an assortment of loud, harsh chuckles and squawks, varied by raucous cackling like mock laughter.

Ecology and habits: Occurs in evergreen and deciduous forests, especially riverine forest and in the hills above 500 m elevation, but also in the lowland. Where it overlaps



Malabar Grey Hornbill; male with lizard, Karnataka state. Niranjan Sant

with Indian Grey Hornbill, this species prefers the higher terrain with dense tree cover. It extends from forest into nearby cultivation and villages to feed. It flies with a strong flapping alternated with glides and hops among the branches on to the outer branches of large fruiting trees. The food is mainly fruits and berries, with *Actinodaphne*

(Lauraceae) and *Olea* (Oleaceae) comprising 55% when breeding but particularly figs during the non-breeding season (3 species, 60%), also occasionally flowers. It also takes some animal prey such as insects and small reptiles. A study of a male feeding the female and later young at the nest found that it brought mainly lipid-rich fruits (37%), such as



Malabar Grey Hornbill; female. Raphael Jordan



Malabar Grey Hornbill; male preening in fruiting tree, Kerala. Garima Bhatia



Malabar Grey Hornbill; male at nest, Karnataka state. Notice the male also feeds with fruits. Niranjana Sant

MALABAR GREY HORNBILL

Aphanamixis polystachya, then figs (26%) and other fruits (23%). The remaining 14% was animal food such as insects, small reptiles and rodents; this part increased after the young hatched. This hornbill is apparently sedentary but will move around locally, especially within deciduous forest parts of the range; flocks of up to 20 individuals may gather at favourable feeding sites.

Breeding ecology: This species is well studied, and the nesting ecology is well understood. It is monogamous and breeds in pairs; eggs are laid in the beginning of the year Jan–May, which is at the end of the local dry season. The nest is a cavity in a large live forest tree. During a survey in the Mudumalai area, 70% of nests were found in trees of species

Lagerstroemia microcarpa, *Terminalia bellirica* and *T. crenulata*. The nest is on average 16.5 m above ground. 80% of cavities were in natural rot in the wood, the other 20% were excavated by other birds. The entrance diameter is about 8 cm, mean tree diameter around the cavity 42 cm. One nest was 25 cm wide, 36 cm deep with a 63 cm chimney above. The same nest sites are used by the pair year after year. The female enters and seals the entrance herself using her droppings as cement. A clutch of 2–4 eggs are laid; the male will feed the female and later the chicks at the nest. During one study, 2,397 items of food were delivered during the whole nesting cycle. While incarcerated, the female will complete a moult of her flight feathers. The incubation period is about 40 days; fledging period is about 46 days.

The female will emerge together with the chicks. In one study, out of 27 nests, 24 were successful with chicks fledging.

Status: This species is still locally fairly common over its large range that covers some 230,000 km². However, Kinnaird & O'Brien (2007) found that out of this range area only some 22,452 km² was optimal habitat. The global population size has not been quantified but is believed to be substantial. The species occurs in five main areas, including many protected areas such as Periyar NP and Indira Gandhi and Perambikulam Wildlife Sanctuaries. Habitat destruction, especially in the northern part of the range, has caused this hornbill to decline in numbers, but it is not globally threatened.



Above and facing page: The male Malabar Grey Hornbill brings food to the nest, Karnataka state. In one study 86% of the food was fruits, 14% was animal prey. Niranjana Sant

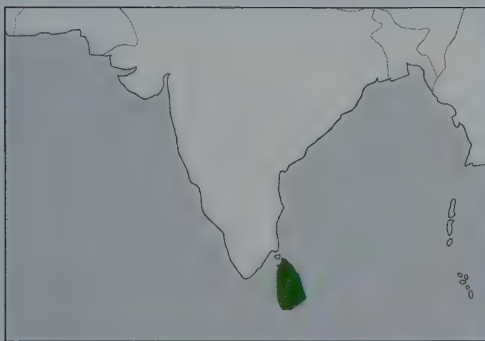


SRI LANKAN GREY HORNBILL

Ocyeros gingalensis (*Buceros gingalensis* Shaw, 1811)

Taxonomy: Monotypic. Genus in the past combined with African *Tockus* but differs in breeding ecology. Sometimes considered conspecific with Malabar Grey Hornbill but there are significant differences in bare-part colours, morphology and behaviour.

Distribution: Endemic to Sri Lanka.



Description: 45 cm. Male 238 g. Small grey hornbill with pale underparts and rufous vent. Sympatric larger Malabar Pied Hornbill has distinct pied plumage and much larger casque. Male has creamy bill, paler at tip with very low casque; female is smaller with blackish bill but for a yellow streak. Juvenile has smaller pale greenish bill. Voice is a loud *ka*, often in an accelerating series *ka-ka-ka-ka*; male and female will call in duet.

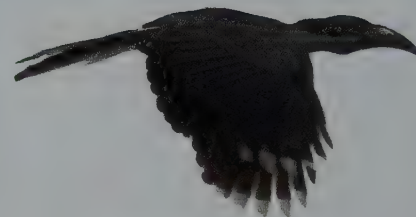
Ecology and habits: Occurs in evergreen and deciduous forests, especially in low moist areas with dense forest and creepers. It is somewhat adaptable and extends into cultivated areas and hills, less numerous in the hills but has been recorded to 1,200 m elevation. It is more widespread on the island than the sympatric Malabar Pied Hornbill, and also occurs outside of protected areas. The food is mainly fruits, particularly many small figs, but it will take a variety of both wild (38 species) and cultivated (two species) varieties. It also



Sri Lankan Grey Hornbill; male. Amila Salgado



Sri Lankan Grey Hornbill; juvenile. Nayana Wijayathilaka



Sri Lankan Grey Hornbill; female.
Gehan de Silva Wijeyeratne

takes at least 18 types of animal prey; insects, scorpions, frogs, lizards and rodents have been recorded. After the breeding season in Sep-Oct it has been reported to be somewhat nomadic; it will move into higher country looking for fruiting trees, where small groups might form.

Breeding ecology: Eggs are laid Mar-Jul, usually in May, but also as late as Oct. The nest is a natural cavity 2–21 m up in a tree; an old woodpecker hole can also be used. A clutch of 1–3 eggs are laid; the male will feed the female and later the chicks at the nest; fruits are regurgitated from the gullet, animal prey is delivered in the tip of its beak. While incarcerated, the female will complete a moult of her flight feathers. The incubation period is 28–30 days; fledging period is estimated at 55 days. The female will emerge from the nest about 4 weeks before the chicks are ready to fledge.

Status: This species is still locally fairly common where the right habitat of lowland forest is available; it is less numerous elsewhere. Kinnaid & O'Brien (2007) found that out of a range area of 65,225 km² only 2,493 km² was optimal habitat. A survey published in 2011 found that the overall distribution was stable, but abundance declining. Being somewhat adaptable, and with a population that appears to be still widespread and substantial, it is not considered to be globally threatened.



Sri Lankan Grey Hornbill; male. Pathmanath Samaraweera



Sri Lankan Grey Hornbill; female. Mapalagama Premasiri



Sri Lankan Grey Hornbill; female, Sinharaja. Kalyan Varma



Sri Lankan Grey Hornbill; male. Chandrasri Narampanawa

BUSHY-CRESTED HORNBILL

Anorrhinus galeritus (*Buceros galeritus* Temminck, 1831)



Taxonomy: Monotypic. Previously also combined with both *Ptilolaemus* species in the genus *Anorrhinus*, and most closely related to them. Populations from Malay Peninsular and those from Borneo suggested as separate subspecies but neither are sufficiently distinct.

Distribution: Sunda subregion; extreme south Myanmar, south Thailand, Peninsular Malaysia, Borneo as well as Sumatra and Natuna Islands, Indonesia.



Description: 90 cm. 1134–1247 g. Medium-sized hornbill with all-dark-brown body plumage and bare bluish skin around eye and on throat. Tail is grey-brown with broad, darker tip. Male has black bill and small casque; female's bill is yellow with black base and small black casque. First year juvenile resembles adult male, except for paler brown tips to feathers, olive-green bill and yellow skin around eye. Vocal and noisy, the high-pitched, gull-like communal squawking can be heard over a mile away. Alarm call is a short *aak-aak-aak*.

Ecology and habits: Found in primary tropical rainforest, also mature secondary forest, from the coast into the hills at 750 m elevation, recorded up to 1,800 m. Prefers dense areas with closed canopy and many fruiting trees. It lives in noisy and mobile groups of 3–15 birds, rarely up to 20. It moves through the



Bushy-crested Hornbill; female on a fruiting *Aglaia* tree. Tim Laman

forest mainly at canopy level flying just short distances from tree to tree, and it feeds inside or just below the canopy. The food is mainly fruits, especially lipid-rich varieties such as *Aglaia spectabilis*, *Dysoxylum* spp (Meliaceae), *Litsea* spp (Lauraceae) and *Horsfieldia* and *Myristica* spp (Myristicaceae) recorded from southern Thailand; about 30 types of fruits have been identified and only about 10% of the diet is figs. Takes animal food regularly, about 25% of the feeding time is spent actively hunting prey; it searches through the canopies and probes the bark to find cicadas, other invertebrates, lizards and frogs. Members in the group may

combine to hunt prey or to chase competitors, such as other hornbills, out of fruiting trees. Sedentary and territorial, there are no reports of movements apart from immatures dispersing.

Breeding ecology: The nesting season is largely aseasonal but nesting usually happens during periods of abundant food. The nest is a natural cavity in a large forest tree; the dominant female will enter and lay a clutch of 2–3 eggs. In southern Thailand, female seals its nest in Mar in a cavity of trees of genera *Hopea*, *Shorea* (Dipterocarpaceae) and *Syzygium* (Myrtaceae), and 1–3 chicks fledge in Jun. A



Bushy-crested Hornbill; female at nest during the early stage of breeding.
Thailand Hornbill Project

pair could breed twice in one year or only every other year. This species is co-operative during nesting; the dominant pair will breed and the other 1-5 birds in the group help out. The incubation period is about 30 days; the female will moult her flight feathers while incarcerated. The female and the chicks are fed by the other group members, mainly males, which regurgitate food at the nest. The female leaves the nest about a week before the chicks fledge; the nestling period is about 60 days. The entire nesting cycle is 96 days (range 76-121 days).

Status: This hornbill is widespread, but generally scarce and at low densities; in ideal habitat it can be locally common with a reported range of only 1.2 km² per group. Occurs in most lowland rainforest reserves within its range, but outside of protected areas available habitat has been shrinking rapidly during the last few decades. It is able to adapt to tall, selectively logged forest conditions, and it also occurs in lower montane forest. In a national survey of hornbill populations in Thailand, abundance indices from an average of 145 km line transects (42-293 km in five forest complexes of its range) were 0.08-1.4 birds per km from four complexes. At least 18 nests are known in Hala-Bala Forest Complex. In Brunei, abundance indices from line transect surveys of 2-17 km from six localities (every five years during 1991-2001) were 1.6-2.6 birds per km from two localities. Although the population appears to have been declining, the species is not considered threatened with extinction. CITES Appendix II.



Bushy-crested Hornbill; male at nest. Thailand Hornbill Project



Bushy-crested Hornbill; male with centipede prey, Endau Rompin, Malaysia. Morten Strange

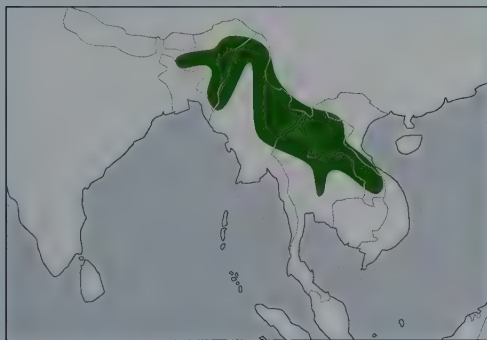
WHITE-THROATED BROWN HORNBILL

Ptilolaemus austeni (*Anorrhinus austeni* Jerdon, 1872)



Taxonomy: Monotypic. Originally placed in genus *Anorrhinus*, together with its sister species Tickell's Brown Hornbill with which it was also considered conspecific; the two differ in some details of plumage and bill colour. Birds of Thailand and Indochina are sometimes treated as race *indochinensis* but appear inseparable from other populations.

Distribution: Occurs from north-east India and south China across north Myanmar, north and central Thailand, Laos and west Cambodia to north-west Vietnam.



Description: Male 73–80 cm, female smaller. Male 710–900 g. Medium-sized hornbill with generally dark brown plumage and rufous underparts, wings and tail tipped white. Male has whitish cheeks and throat and creamy bill and casque. Female has darker brown underparts with dark cheeks and throat; ivory white bill and small casque. Both have blue ring of naked skin around eyes. Juvenile resembles adult male, except for paler brown tips to feathers; short yellow bill and orange skin around eyes; moults into adult plumage when around a year old. The call is somewhat similar to Bushy-crested Hornbill but less harsh, a loud series of repeated screams, croaks and chuckles.

Ecology and habits: Found in closed forest, both evergreen and deciduous, from the



White-throated Brown Hornbill; two male nest helpers, immature (left) and mature (right) waiting to feed at nest. Narong Suwannarong

Facing page: White-throated Brown Hornbill; two males, breeding male at the nest and the helper in the background. Narong Suwannarong

lowlands to the lower montane forest with pines and oaks, mainly in lower hills. It is recorded to 1,000 m elevation in India, 1,500 m in South-east Asia and 1,800 in Tibet and Yunnan province, China. It is a social bird that lives in vocal and mobile groups of 2–15 birds, up to 50 in one group have been reported. It

moves through the forest at canopy level and feeds actively inside or just below the canopy. The food is mainly fruits, 41 different varieties have been identified at Khao Yai NP. During a breeding survey in Thailand, recorded food by weight was 22% figs, 38% other fruits and 40% animals. It consumes animal prey as many



WHITE-THROATED BROWN HORNBILL



White-throated Brown Hornbill; two juveniles ready to emerge, with father in attendance. Narong Suwannarong



White-throated Brown Hornbill; female breaking out. Narong Suwannarong

as 41 species. Prey included many arthropods, but also snails, earthworms and such vertebrate prey as bats, snakes, lizards and bird chicks and eggs. Sedentary and territorial, the mean home range of a breeding group is only 4.3–5.9 km²; there are no reports of movements apart from immatures dispersing. In non-breeding season a number of up to 80 birds can be seen roosting together in Khao Yai NP.

Breeding ecology: The nesting season starts in the beginning of the year, in Thailand eggs are laid Feb–Mar and chicks fledge May–Jun, in India Mar–Jun. This species is co-operative during nesting; the dominant pair in the group will breed, only males will help out. The nest is a natural cavity or an old woodpecker hole at 5–27 m (avg. 13 m) up in a large forest tree, often a *Dipterocarpus* or *Cleistocalyx* (formerly *Syzygium*). The clutch is 2–3 eggs, rarely up to 5. The incubation period is 27 days; the female will moult her flight feathers while incarcerated. The female and the chicks are fed by 1–5 male nest helpers; a mean rate of food brought to the nest is 17 g per hour. The female leaves the nest together with the chicks; the nestling period is about 62 days. The entire nesting cycle is 90 days on average (range 73–112 days).



White-throated Brown Hornbill; female. Narong Suwannarong

Status: In spite of its fairly large range, this hornbill is not really numerous anywhere, except in Laos where it is reported as locally common. It is rare in China and scarce in India where the best place to see it is the large Namdapha NP near the Myanmar border. It is rare to uncommon in Vietnam, and scarce in Cambodia, Myanmar and Thailand. It has declined in numbers throughout most of its range due to habitat loss, and it has disappeared from hills in north-west Thailand and east Myanmar. The remaining habitat is severely fragmented, the population in Thailand's Khao Yai NP is now totally isolated. A national survey of hornbill populations in Thailand during 2004–2008 found that its density was 4.4 birds per km² in Khao Yai NP, while abundance indices, from an average of 162 km line transects (61–262 km in other five forest complexes of its range) were 0.3 birds per km from only one forest complex. Throughout its range, commercial and illegal logging operations, as well as shifting cultivation and human settlements, have cut into this hornbill's available habitat, and it is also hunted by the hill tribes. The population has not been estimated but is believed to be declining; in view of this, the species is considered Near Threatened with global extinction. CITES Appendix II.



For comparison: The closely related Tickell's Brown Hornbill; this is a subadult helper at a nest inside the Huai Kha Khaeng WS, Thailand. Tim Laman

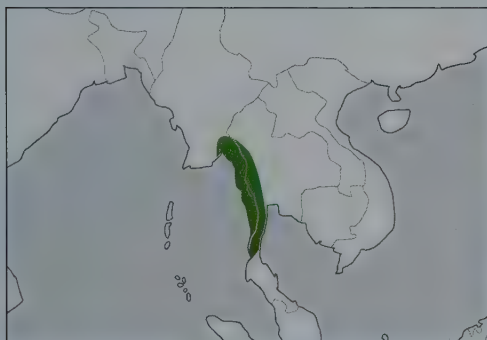
TICKELL'S BROWN HORNBILL

Ptilolaemus tickelli (*Buceros tickelli* Blyth, 1855)



Taxonomy: Monotypic. Previously placed in genus *Anorrhinus*, together with White-throated Brown Hornbill with which it was also considered conspecific; the two differ in some details regarding plumage and bill colour.

Distribution: Endemic to a small area of south Myanmar and adjacent west Thailand.



Description: 65–75 cm. Male 854–912 g; female 683–797 g. Medium-sized hornbill with generally dark brown plumage and rufous underparts, wings and tail tipped white. Male has dull rufous cheeks and throat and creamy bill and small casque; female is browner with darker cheeks and black bill and casque; both have small patch of blue naked skin around eye. Juvenile resembles adult male but paler brown with light yellow short bill without casque. The call is very similar to that of the White-throated Brown Hornbill.

Ecology and habits: Found in both evergreen and deciduous forests, it prefers dense primary forest. From the foothills to 1,500 m elevation, occasionally visits higher forests. Similar to its sister species, it lives in a small group of 5–7 birds all year round, but large groups of more than ten can be seen. Food comprises both fruits and animals where fruits include *Polyalthia viridis* (Annonaceae), *Canarium euphyllum* (Burseraceae), *Cryptocarya*



Tickell's Brown Hornbill; male with food. Thailand Hornbill Project

pallen and *Beilschmiedia gammieana* (Lauraceae), *Aglaia spectabilis* (Meliaceae) and *Horsfieldia glabra* and *Knema* spp (Myristicaceae); animals are insects, centripedes, snakes, skinks and lizards, crabs and mice.

Breeding ecology: The nesting season starts in the beginning of the year, in Myanmar eggs are laid in Feb–Apr; in western Thailand, female enters the nest in Jan–Feb and chicks fledge in May–Jun; nesting cycle takes 98 ± 22



Tickell's Brown Hornbill; male at nest.
Thailand Hornbill Project



Tickell's Brown Hornbill; male at nest.
Thailand Hornbill Project



Tickell's Brown Hornbill; female. Thailand Hornbill Project



Tickell's Brown Hornbill; male at nest.
Thailand Hornbill Project

days, which is slightly longer than that of the White-throated Brown Hornbill. This species is co-operative during the nesting with 1-5 male helpers. The nest is a natural cavity 1.5-28 m up in a forest tree, mainly *Lagerstroemia* spp (Lythraceae). During one survey, a group of 8-10 males was present at the nest, and at least five of these males brought food to the nest. Radio tracking of six males (four breeding males and two nest helpers) in dry evergreen forest in Thailand showed extensive ranges between 10-57 km² (average 33 km²) for all year round, 12-37 km² (average 28 km²) in the breeding season and 9-11 km² (average 11 km²) in non-breeding season.

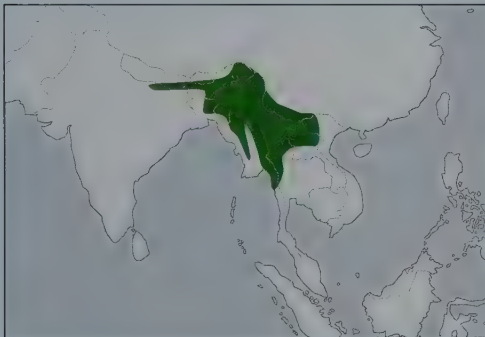
Status: The total distribution range has been estimated to cover 6,246 km², but suitable habitat is much smaller and fragmented covering only 1,710 km² according to Kinnaird & O'Brien (2008). In Thailand, occurs within the Western Forest Complex (18,730 km² which includes Huai Kha Khaeng, Thung Yai Naresuan, Umphang Wildlife Sanctuaries and others) downward to Khaeng Krachan Forest Complex (4,373 km²: Khaeng Krachan NP, Mae Num Pachi WS and Kui Buri NP). In a national survey of hornbill populations in Thailand during 2004-2008, density was 12-21 birds per km² in Huai Kha Khaeng and Thung Yai Naresuan WS in non-breeding season, while abundance indices, from an average of 85 km line transects (42-128 km in other two forest complexes of its range) were 0.2-0.3 birds per km. Commercial and subsistence logging as well as shifting cultivation and possibly hunting by hill tribes are threats to this species, but more surveys are needed. The population is believed to be small in other areas and declining; in view of this, the species is considered Near Threatened with global extinction. CITES Appendix II.

RUFIOUS-NECKED HORNBILL

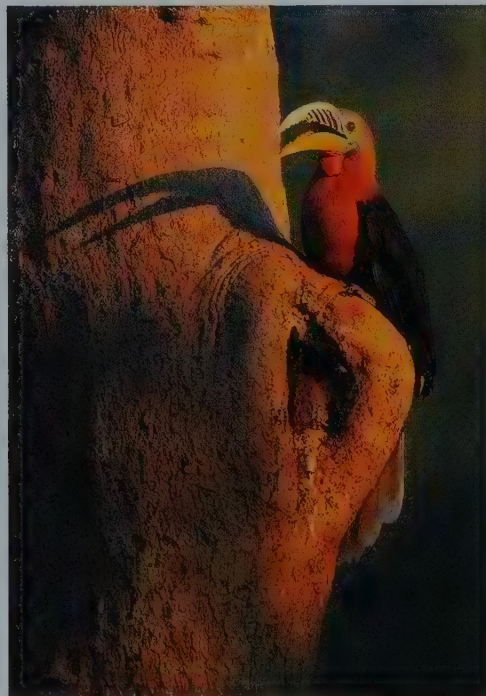
Aceros nipalensis (*Buceros nipalensis* Hodgson, 1829)

Taxonomy: Monotypic. Currently once again considered distinct and the only member of its genus, although it was recently joined by some of its closest relatives in a subgenus *Rhyticeros* within a greater genus *Aceros*.

Distribution: Found in northern parts of South-east Asia; from Bhutan and north-east India, east across Myanmar to south China, north and west Thailand, north Laos and north-west Vietnam.



Description: 99–122 cm. Male 2500 g. Female 2270 g. The most colourful large hornbill, with glossy black wings with white trailing edge, mantle and top half of tail black with rest white. The male has rufous head, neck and underparts, pale ivory bill with black grooves on upper mandible, and turquoise blue orbital skin connected with cobalt blue cheeks and scarlet red pouch with dark blue line. It is distinctive within its range. The female is all-black but can be distinguished from female Wreathed and Plain-pouched Hornbills where they overlap by blue (not reddish) bare skin around eye, red (not blue) pouch and heavy black stripes on upper mandible of bill, without visible casque, and wings with white trailing edge. Juveniles of both sexes resemble adult male in plumage but paler, and bill smaller without black grooves. The number of the grooves is



Rufous-necked Hornbill; male landing at a Tickell's Brown Hornbill's nest in an *Amoora* sp tree. Tim Laman

somewhat related to the bird's age. The call is a mellow but powerful cuckoo- or pigeon-like series of descending cooing notes *kup-kup* ... *ku-kup-kup*.

Ecology and habits: Occurs in extensive tracts of primary evergreen and deciduous forests. It is a lower montane species that prefers remote forested ridges and hillsides in the 600–1,800 m elevation range. Has been recorded as low as 150 m and as high as 2,200 m. It frequently forages along watercourses in hill evergreen forest. In Huai Kha Khaeng WS, Thailand, it feeds on fruits of 17 identified species or 74% of total diet dominated by *Polyalthia simiarum* (Annonaceae), *Beilschmiedia gammeiana* (Lauraceae), *Knema laurina* (Myristicaceae) and *Aglaia cucullata* (Meliaceae); figs constitute only 4% and animal food

22% of diet. Among 25 identified animal prey, crabs, snakes (*Acanthosaura* sp), cicadas and frogs are dominant. Feeds inside the canopies, commonly comes to the ground, particularly by creeks. It is probably sedentary and territorial; it moves in pairs or in small family groups of 4–5 birds, occasionally more, up to 15 birds. From radio tracking it seems to stay within home range of about 25 km² all year round in hill evergreen forest of Huai Kha Khaeng WS. In non-breeding season it travels extensively up to 340 km locally in search of fruiting trees or 3.7 km daily which is not much different from daily travels in the breeding season (3.5 km). A family roosts in hill evergreen forest at 900–1,000 m a.s.l. and within 200 m from a watercourse.

Breeding ecology: Breeds in the first half of the year, courtship display has been observed in mid-April in Bhutan, eggs are laid from Jan–Jun. In Thailand, female seals in Jan–Feb, and 1–2 chicks fledge in May–Jun. The nest is a natural cavity in a large, live forest tree, particularly in *Cleistocalyx nervosum* (Myrtaceae) (68% of total nest trees), some 10–30 m above the ground in a hill evergreen forest (>1,000 m a.s.l.). The female seals herself in using her droppings and food pulp, and lays 1–2 eggs. She stays in the nest for 121 days (range 105–152 days), and emerges with the chicks. However, exact incubation and fledging periods are not known. At Huai Kha Khaeng, Thailand, 22 nesting attempts studied involved 22 pairs, with 15 pairs (68%) successfully raising a mean of 1.3 young per nest.

Status: This hornbill is widespread over a large range of some 285,000 km² in total, but the core habitat is fragmented and shrinking due to deforestation. The species is considered locally extinct in Nepal and close to extinction in Vietnam. It is very rare in China and has





Rufous-necked Hornbill; female feeding on *Amora* fruit in Huai Kha Khaeng WS, Thailand. Thailand Hornbill Project



Rufous-necked Hornbill; male, Bhutan. Notice the many grooves on upper mandible indicating old age. Paul Noakes



Rufous-necked Hornbill; male at nest, showing colourful naked skin of facial and gular pouch. Thailand Hornbill Project

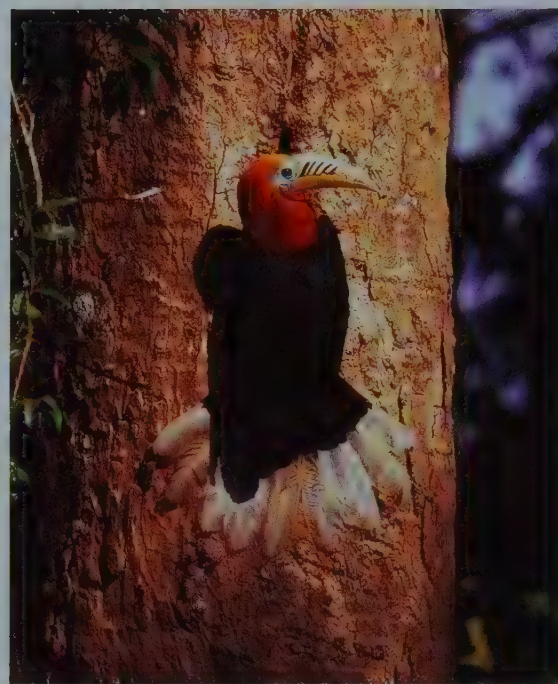
RUFOUS-NECKED HORNBILL



Rufous-necked Hornbill; male at nest. Notice the molting condition. This nest was located at above 1,000 m a.s.l. in hill evergreen forest of Huai Kha Khaeng WS, Thailand.
Thailand Hornbill Project



Researcher Dr. Rungsrit Kanjanavanit peeking out from a hide in the Huai Kha Khaeng Wildlife Sanctuary in western Thailand; the nesting tree (*Syzygium* sp) can be seen behind (circled). Morten Strange



The view from the hide through a 500mm lens. Morten Strange



Rufous-necked Hornbill; male at nest in large *Syzygium* sp tree, Thailand. Morten Strange

disappeared from the Xishuangbanna Nature Reserve in Yunnan; in India it is rare as well; a healthy population survives in Namdapha NP, Eaglenest WS, Arunachal Pradesh and Neora Valley NP, West Bengal. It is still widespread and locally fairly common in Bhutan such as the Thrumshingla NP and it might be locally common in north Myanmar. In Laos, it occurs in the important Nakai-Nam Theun Biodiversity Conservation Area. In Thailand, it has disappeared from the north of the country and is now only found in Western Forest Complex (WEFCOM), where there are viable populations in wildlife sanctuaries of Huai Kha Khaeng, Umphang and Thungyai Naresuan, as well as Mae Wong NP. During a national survey of hornbill populations in Thailand during 2004–2008, density was 3–7 birds per km² in Huai Kha Khaeng and Thungyai Naresuan WS, while from an average of 142 km line transect surveys (103–190 km in other two forest complexes of its range) this species was absent. This hornbill depends on extensive tracts of forest with large trees, particularly in lower montane forest, for feeding and nesting, a habitat that is fast being degraded, due to commercial and illegal logging, slash-and-burn cultivation and clearance for developments. In many parts of the range, the species is also hunted by local hill tribes for food, for the pet trade or for ornamental use of its bill. The world population has been estimated to be more than 2,500 but less than 10,000 individuals and declining. Due to these factors, this hornbill is considered Vulnerable to global extinction. CITES Appendix II.

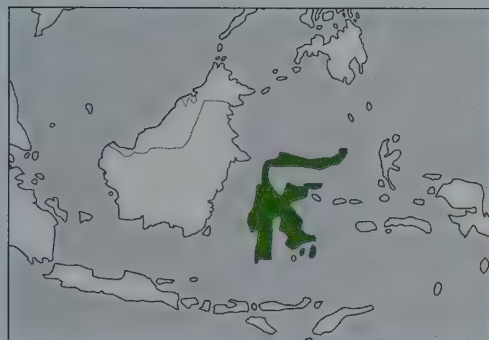
KNOBBED HORNBILL

Rhyticeros cassidix (*Buceros cassidix* Temminck, 1823)



Taxonomy: Monotypic. Previously considered in genus *Aceros*. Thought to form a superspecies with Wrinkled Hornbill, Writhed Hornbill and Rufous-headed Hornbill. Birds from smaller islands are smaller and have been separated as the subspecies *brevirostris*, but probably just a local clinal effect.

Distribution: Endemic to Indonesia. Occurs on Sulawesi and the nearby islands of Lembeh, Togian, Muna and Butung.



Description: 70–80 cm. Male 2360–2500 g. It is the only large hornbill within its range. Black with white tail, orange-yellow bill and high casque; pouch and facial skin blue with darker line on pouch in both sexes. Male has brownish head with darker crown and large red casque; female is smaller with black head; casque is yellow. Juveniles of both sexes like adult male in plumage except for smaller plain yellow casqueless bill; the casque starts to develop at about 10 months of age, when females begin moult into black body plumage. The voice is a single gruff bark, *grrok*, repeated 2–3 times.

Ecology and habits: Well studied. Occurs in lowland rainforest from the coast up to the hills, mainly below 1,100 m elevation, recorded up to 1,800 m. Nests in primary forest, ventures into secondary forest, woodlands



Knobbed Hornbill; male. Pete Morris

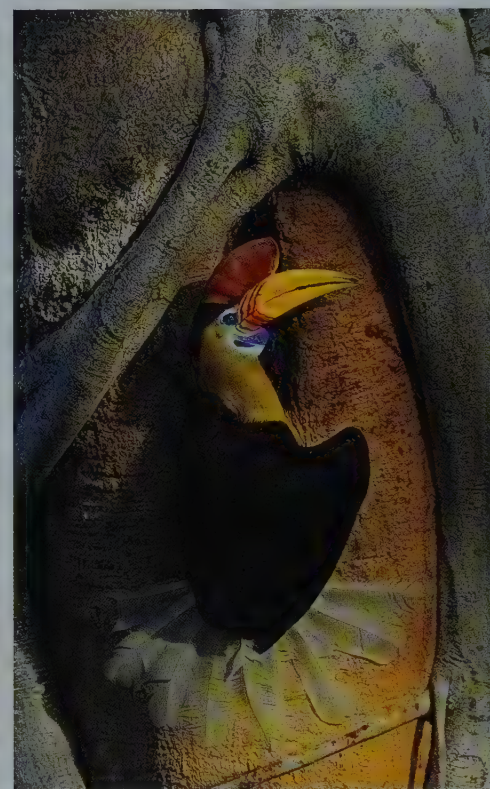
and nearby plantations to feed. Food is mainly fruits; during breeding season a great variety of fruits (52 species) are taken, 60–82% figs (Moraceae: 19 species) followed by *Polyalthia* (Annonaceae: 4 species) and *Syzygium* (Myrtaceae: 3 species), but only about 1% of diet is animal food such as insects, bird eggs and nestlings. During non-breeding, 35 different varieties used, including 17 species of figs providing 85% of diet. It feeds mainly in the canopy of large trees, is especially fond of large red figs and will chase off other birds and primates at feeding sites. Wanders far during

non-breeding season in search of fruiting trees, flocks numbering up to 50 individuals can cover an area of 30–60 km² daily. Kinnaird & O'Brien (2007) reported a home range of 42 km² during non-breeding and 8 km² during breeding periods.

Breeding ecology: Monogamous; like other hornbills, the male and female are believed to pair for life. The breeding season has a wide range during Jun–Jan. Eggs are laid during the dry season, usually Jun–Sep in a nesting cavity some 12–53 m up in a large live forest tree; on



Knobbed Hornbill; female. Jon Hornbuckle



Knobbed Hornbill; male at nest. Tim Laman

Sulawesi the preferred nest trees are *Palaquium amboinense* (Sapotaceae) 39%, *Dracontomelum dao* (Anacardiaceae) 14% and *Alstonia ranvofia* (Apocynaceae) 10%; at least 15 tree species have been identified. Surveys show that 50–62% of nesting trees are reused year after year. The female seals herself into the nest using her own droppings. She lays 2–3 eggs over 5–8 days, usually one chick will be reared, rarely two. The incubation period is 32–40 days; the male will feed the female and later the chicks with regurgitated food. The female emerges after 58–140 days; she will assist the male in feeding the chick or chicks by providing on average 14% of the food. Young fledge from 80% of nesting attempts; the mean total nesting cycle is 139 days.

KNOBBED HORNBILL

Status: This hornbill is still locally common where the right habitat is available. It can be found in all the major national parks on Sulawesi, and locally, where there are many fig trees; it can be very common with densities reaching 10 pairs per km². However, outside of protected areas, forest cover is declining fast, especially so on the smaller islands, and 60% of the lowlands have been cleared. Habitat conversion, gold mining, forest fires and hunting for food are issues of concern and the species was uplisted from Least Concern to Vulnerable to global extinction in 2012. CITES Appendix II.



Knobbed Hornbill; male flying to nest. The nest tree is entwined by a strangler fig. Tim Laman

Knobbed Hornbill; male at nest. Jon Hornbuckle





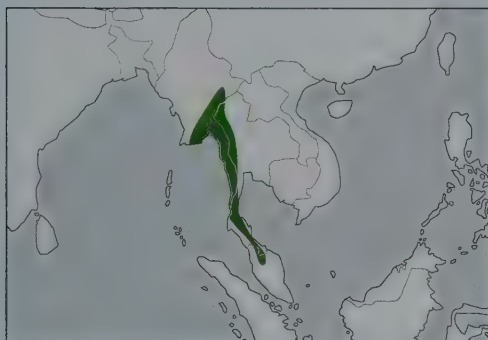
PLAIN-POUCHED HORNBILL

Rhyticeros subruficollis (*Buceros subruficollis* Blyth, 1843)



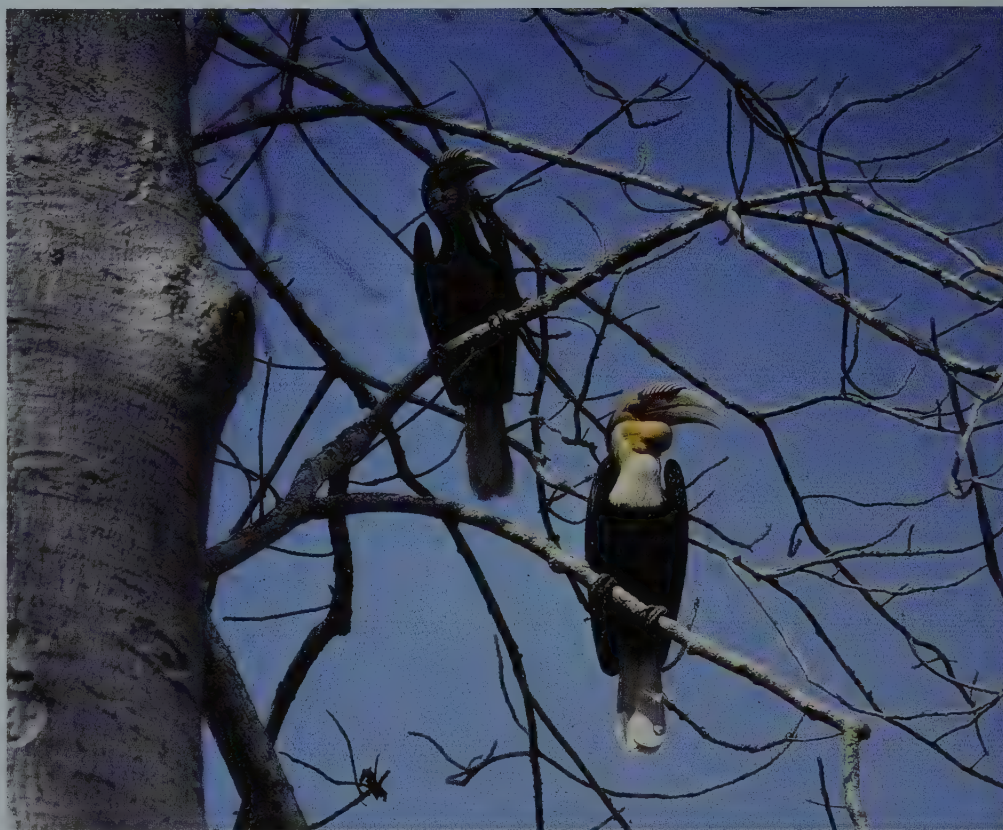
Taxonomy: Monotypic. Previously considered in genus *Aceros*. Previously considered conspecific with Papuan Hornbill or with Wreathed Hornbill, but differs from both in size, bill shape and bare-part colours.

Distribution: Found in south Myanmar, west and south Thailand as well as northern Peninsular Malaysia. Previous reports from northern Myanmar, India and Sumatra, Indonesia and Borneo now considered invalid based on misidentification.



Description: 75–90 cm. Male 1815–2270 g. Very similar in appearance to the sympatric Wreathed Hornbill, but smaller. The male has a dark reddish base to bill, no ridges on mandibles, and there is no black bar across the yellow pouch. Female is like female Wreathed except for plain bill (no ridges) and lack of black bar across blue pouch. Juveniles of both sexes like adult male in plumage, and without bar across paler yellow pouch, but bill small and pale horn-coloured. The call is a harsh bark; in flight a 3-note *ehk-ehk-ehk*.

Ecology and habits: Occurs in rainforest and mixed deciduous hill forest, especially along river valleys; mainly in the lowlands, recorded from coastal flats to 1,000 m elevation. It prefers pristine primary forest and seems to avoid disturbed and logged areas. Feeds mainly in



Plain-pouched Hornbill; adult pair, male below. The pair is sitting in front of their former nest, which is an old woodpecker hole in a *Tetrameles* sp tree. Thailand Hornbill Project

the canopy of large forest trees, it has also been known to descend to the ground. Feeds mainly on fruits including *Ficus racemosa* (Moraceae), *Polyalthia* spp (Annonaceae), *Strombosia* sp (Olacaceae) and *Knema* spp (Myristicaceae) recorded in a mixed deciduous forest, western Thailand. It also takes some small animal food; in northern Malaysia it has been reported to hawk for newly emerged mayflies (Ephemeroptera). Its movements are not well understood, but large flocks travelling between roosting and feeding areas after the breeding season have been recorded from northern Malaysia.

Breeding ecology: Studies in Huai Kha Khaeng WS, Thailand, found that more than 90% of the nests are in cavities excavated by woodpeckers, particularly by Great Slaty Woodpecker (*Muelleripicus pulverulentus*). Nesting season starts in the beginning of the year, Jan-Feb and lasts until May or Jul. This species only selects secure sites in immensely high trees for nesting, and the majority of nest cavities are in *Tetrameles nudiflora* trees (Datiscaceae) (76.5%) of a mixed deciduous forest; 17 nests in Huai Kha Khaeng, Thailand, were 11–33 m (average 18 m) above the ground

Facing page: Plain-pouched Hornbill; male, Huai Kha Khaeng Wildlife Sanctuary. Chien Lee



PLAIN-POUCHED HORNBILL

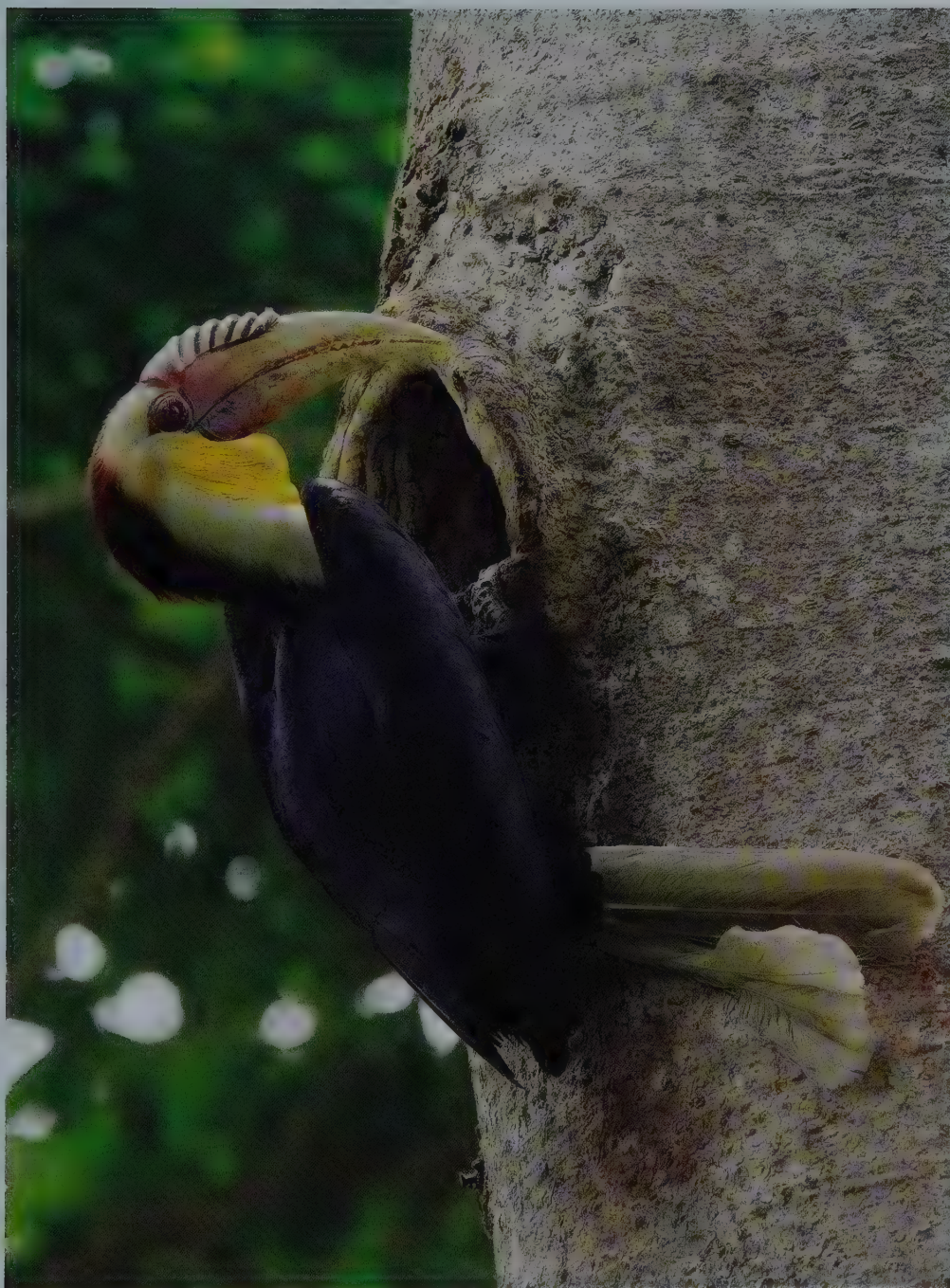
in 30–55 m tall trees. The female stays inside the nest throughout the nesting cycle. She uses dried mud and droppings for cement. The clutch is 1–2 eggs, less often 3. The male feeds the female at the nest. A young was observed being fed in a nest hole in early May. Total nesting cycle in Thailand is 115 days on average (range 98–146 days). Otherwise information on incubation and nestling periods is unknown.

Status: This species seems to have undergone a rapid decline in population, and it is now very rare in mainland Myanmar, although 150 individuals were counted at a roost on Lampi Island Marine National Park. National survey of hornbill populations in Thailand during 2004–2008 abundance indices from an average of 157 km line transects (42–293 km in four forest complexes of its range) were low (0.09–0.7 bird per km) in two forest complexes. However, from southern Thailand there are still reports of large roosting flocks of 700–900 birds at Bang Lang NP in the extreme south of the country. The species occurs in many other protected areas of Thailand, notably Huai Kha Khaeng, Hala-Bala, Khlong Saeng and Mae Nam Phachi Wildlife Sanctuaries, and Khao Laem, Kaeng Krachan and Sri Phang-nga National Parks. Recently, 345 birds were recorded at a roosting site in an oil-palm plantation near Klong Phraya WS, Surat Thani Province, southern Thailand. At the Belum-Temengor Forest Complex in northern Malaysia, large flocks have been counted flying to and from roost to feeding areas; this area seems to be a stronghold for the species, at least during the non-breeding season; during a survey in September 2008, between 1,520 and 3,261 individuals were counted each morning. Location of the nesting areas for such large numbers remains to be established. Because of a small population, declining rapidly due to habitat loss and hunting, this species is regarded as Vulnerable to global extinction. CITES Appendix II.



In flight, look for the lack of black bar across the pouch in both sexes to distinguish Plain-pouched Hornbill (above) from Wreathed Hornbill (left). Ong Kiem Sian, Con Foley





Plain-pouched Hornbill; male at nest. This male is at least six years old. Chien Lee



Plain-pouched Hornbill; male at nest. Thailand Hornbill Project



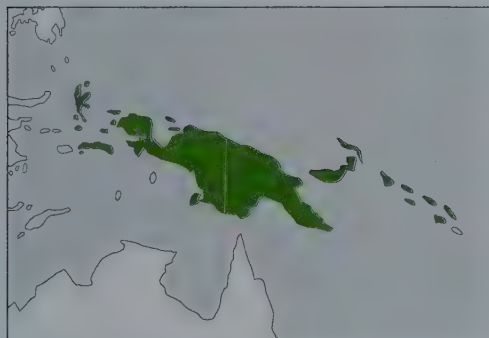
Plain-pouched Hornbill; male at nest. Thailand Hornbill Project

PAPUAN HORNBILL

Rhyticeros plicatus (*Buceros plicatus* J.R. Forster, 1781)

Taxonomy: Monotypic. Previously considered in genus *Aceros*. Previously considered conspecific with Plain-pouched Hornbill as well as Narcondam Hornbill but there are significant differences in morphology, colouration and distribution. Several geographical races have been proposed, but variations in size and colour are gradual, and boundaries difficult to define except for some island forms.

Distribution: Occurs in eastern Indonesia from northern Moluccas east across New Guinea to Bismarck and Solomon Islands. The only Australasian hornbill species.



Description: 65–85 cm. Male 1190–2000 g; female 1500–2000 g. It is the only hornbill within its range. Black with white tail; pouch and facial skin bluish. Male has rufous head and neck, female all-black but differs from female Plain-pouched Hornbill by having blue orbital skin instead of dull red. Juveniles of both sexes like adult male except for smaller casqueless bill. The calls are raucous grunts while perched; in flight it honks continuously, *ka-ka-ka-ka*.

Ecology and habits: Occurs in rainforest from the coast into hills and lower montane areas to 1,500 m elevation, rarely to 1,800 m. Found in both primary and secondary forest as well as riverine woodland and swamp



Papuan Hornbill; adult pair, male on left. Jon Hornbuckle



Papuan Hornbill; adult pair in flight, female leading, Papua New Guinea. Paul Noakes





Papuan Hornbill; female. Pete Morris



Papuan Hornbill; male in flight. Tim Laman

forest. Feeds mainly on fruits, both figs and other varieties, such as *Arenga pinnata*, *A. saccharifera* (Arecaceae), *Canarium indica*, *C. commune* (Burseraceae), *Horsfieldia sylvestris*, *Myristica fatua* (Myristicaceae), *Chisocheton* sp (Meliaceae). It also takes some animal food and has been reported feeding on crabs on the beach and on bee honeycomb. Usually seen as a resident pair together, sometimes in small flocks; at communal roosts hundreds have been reported to gather. It flies high across the forest to and from fruiting trees and will cross open water to get to offshore islands.

Breeding ecology: Poorly known in the wild; in the eastern part of the range it lays 1–2 eggs in the beginning of the year from Jan into May; in the west later, probably Aug–Oct. The nest is inside a cavity in a forest tree, one nest on Seram, Indonesia, was 15 m up in a fig tree; another on Solomon Island was 30 m up in an ironwood. The male feeds the female inside the nest by regurgitating food. In captivity the nesting cycle takes 125 days.

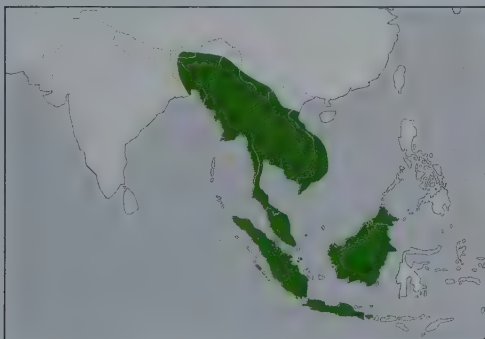
Status: This hornbill has a very wide range; it is fairly tolerant regarding habitat and not globally threatened. It is locally common; in Papua province, Indonesia, 250 birds were counted along a 20 km stretch of river. There are still large tracts of forest available for it on the island of New Guinea, although hunting for food is an issue there. On the smaller islands within its range, forest clearance is more rapid, and populations might be declining, although birds were heard regularly in forest on Bougainville Island east of New Guinea. CITES Appendix II.

WREATHED HORNBILL

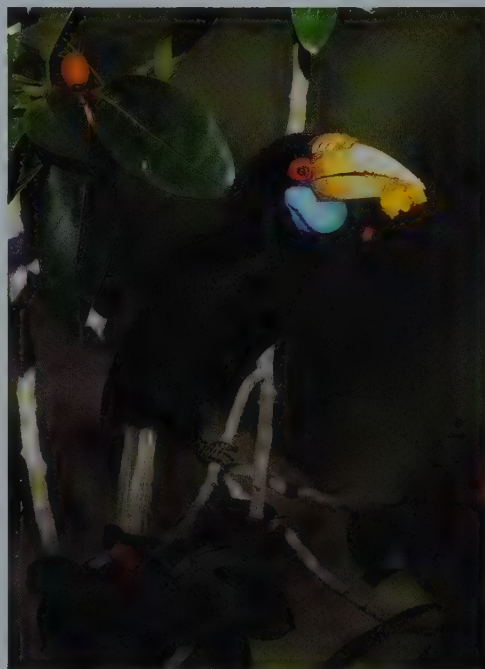
Rhyticeros undulatus (*Buceros undulatus* Shaw, 1811)

Taxonomy: Monotypic. Previously considered in genus *Aceros*. Previously considered separate and then conspecific with Plain-pouched Hornbill. Northern mainland population (somewhat larger) and Borneo population (smaller) has been proposed as subspecies but variations appear gradual and racial separation unwarranted.

Distribution: Found in South-east Asia from southern Bhutan and north-eastern India east to Vietnam and south across Malaysia to western Indonesia east to Borneo, Java and Bali, including some nearby islands.



Description: Male 100–117 cm; female 84–98 cm. Male 2043–3650 g; female 1360–2685 g. Large distinct hornbill (see Plain-pouched Hornbill for differences), male from Wrinkled Hornbill male by brown (not black) cap and nape ivory white with brown at the base (not stained bright yellow), bill with low casque and ridges on bill sides and casque, and black band across yellow pouch. Female has distinct brown ridges on white bill and black band across blue pouch. Juveniles of both sexes resemble adult male in plumage, but bill smaller without casque. The call is a loud series of 2–3 short grunts *oek-uk-uk* used by both sexes, both as a soft contact call or a loud roar. The wing-beats are audible to at least 1 km, softer during rain when feathers are wet.



Wreathed Hornbill; female (top) and male (above) feeding in fig tree, Borneo. Tim Laman

Facing page: Wreathed Hornbill; male at nest. Notice the red-colour bill and casque on this individual, dyed by researchers. Thailand Hornbill Project



Ecology and habits: Occurs in extensive tracts of primary rainforest, mainly in the foothills, but has been recorded to 2,560 m elevation. Locally it will extend into coastal forest and adjacent selectively logged forest. There it feeds mainly on fruits high in large forest trees. This hornbill is well studied; fruits of more than 30 different genera of trees have been identified and are similar to those eaten by Great Hornbill; the proportion of figs and lipid-rich drupes vary according to location and season, and ranges further when not breeding and fewer lipid-rich fruits available. Animal food is generally less than 5% of the diet, but more during the breeding season when extra protein is needed. Prey includes bird eggs and nestlings, reptiles, insects, snails, centipedes and crabs. Although mainly a canopy bird, it has been known to descend to the ground to collect fallen fruit or terrestrial prey. Mainly sedentary but will fly far and



WREATHED HORNBILL

high across the forest to visit fruiting trees, also crossing open water between islands. The home range of a breeding pair is about 10 km² in Thailand. Outside of the breeding season, during the so-called flocking season, the home range extends to about 28 km² for a pair, and large flocks will gather at communal evening roosts, as many as 1,000 birds having been counted in one area.

Breeding ecology: Well studied, especially in Thailand. Eggs laid during Apr-Jun in India, Jan-Mar in South-east Asia, extending to Jun-Aug in Borneo and Java. In Thailand nesting begins in Jan and lasts till May-Jun. The nest is a natural cavity in a large, live forest tree often Dipterocarpaceae (*Dipterocarpus gracilis*, *Hopea*, *Shorea*, *Neobalanocarpus*) and Myrtaceae (*Cleistocalyx nervosum*, *Syzygium*) at 6-45 m above the ground; the same tree can be used year after year. The female seals herself in using her droppings and lays 1-3, usually 2 eggs; only a single chick fledges. The incubation period is about 40 days, the male will feed the female and later the female and the chick inside, regurgitating up to 120 fruits per visit, feeding rate 35 g per hour. The chick fledges after about 90 days in the nest, and the female and the chick will break out and leave the nest together; the total nesting cycle lasts 99-161 days (average 126 days). The family may stick together, sometimes until the next breeding season, but fledgling may separate from its parents as soon as three months after leaving the nest.

Status: This species has a wide range and is not considered globally threatened. During a national survey of hornbill populations in Thailand during 2004-2008, density was 0.4-5.5 birds per km² in Huai Kha Khaeng, Thungyai Naresuan WS, Khao Yai NP and Budo Sungai Padi NP (Hala-Bala Forest



Wreathed Hornbill; males at two nesting sites in Thailand showing different feeding postures. Thailand Hornbill Project



Wreathed Hornbill; female at nest. Here she is inspecting the nest, she later sealed herself in but was then chased off by the former owner. Thailand Hornbill Project



Wreathed Hornbill; adult pair at nest, female below (top), male feeding female in nest (above). Narong Suwannarong

Complex); otherwise abundance indices from an average of 150 km line transects (42–293 km in other 11 forest complexes of its range) were 0.1–1.1 birds per km from nine forest complexes. In Brunei, abundance indices from line transect surveys of 2–17 km from six localities (every five years during 1991–2001) were 0.2–0.7 bird per km from three localities. Otherwise, the population size has not been estimated, but it is not critically low. In prime habitat within its range, this species is still fairly numerous, and it can be found in most of the large rainforest reserves and national parks of the region. However, there is evidence that the available habitat is shrinking and becoming increasingly fragmented and patchy, so the population could be declining and should be monitored. CITES Appendix II.

SUMBA HORNBILL

Rhyticeros everetti (*Rythidoceros everetti* Rothschild, 1897)



Taxonomy: Monotypic. Previously considered in genus *Accros*.

Distribution: Endemic to Indonesia; occurs only on the island of Sumba in East Nusa Tenggara province.



Description: 55 cm. Appears like a small version of Papuan Hornbill, but the only 'wreathed' hornbill with a black tail; base of bill reddish in both male and female; the only hornbill within its range. Juveniles of both sexes resemble adult male in plumage, but casqueless bill smaller. The voice audible up to 500 m is some hard, repeated clucking notes *kok-kok-kok* and a two-note contact call *erm-err*.

Ecology and habits: Found in those patches of primary rainforest that are left on Sumba; extends into nearby secondary forest and cultivation with fruiting trees to feed on. From the coast inland to 950 m elevation and prefers undisturbed forest. It feeds on fruits, especially of the families Meliaceae, Burseraceae, Gnetaceae, Lauraceae and Myristicaceae, free-standing fig, *Ficus variegata*, and presumably also animal food, although this has not been recorded. It is usually seen in fruiting trees, especially figs, moving in pairs, although groups of up to 15 birds may gather in one tree. It flies across the forest and open country to get from roosting



Sumba Hornbill; adult pair, male below. Ron Hoff

site to fruiting trees; up to 70 individuals may gather at roosts.

Breeding ecology: Not well studied. The breeding season probably runs from June to January; mating has been observed in Sep, four nests were found Jul-Sep. The nest is a natural cavity 10–23 m up into a live forest tree, especially *Tetrameles nudiflora* (Datiscaceae), often where a branch has fallen off. A fold in a strangler fig was once used. No information on incubation or fledging periods.

Status: This species has been surveyed regularly since 1989, and in 2011 BirdLife Indonesia estimated the world population to be less than 4,000 birds with an average density of 6 birds per km². Forest cover on Sumba has declined by more than 60% since 1927, and today less than 10% of the island is suitable hornbill habitat. The bird occurs in two protected areas established in 1998, Manupeu–Tanahdaru National Park in the west and Laiwangi–Wanggameti National Park in the east, these two parks covering a total of



Sumba Hornbill; adult pair, male on right. Ron Hoff



Sumba Hornbill; female. Lorenzo Vinciguerra

1,350 km² combined. Additional fragmented forest patches of more than 10 km² in area are also used, if suitable feeding and nesting trees are found; a survey recorded the species from 18 out of 33 such patches. The species is under threat from continued habitat degradation, such as conversion to cultivation, and settlements and forest fires, as well as some hunting for food and capture for the cage-bird trade. Considering its very small world range and rapidly shrinking habitat, the Sumba Hornbill is currently considered Vulnerable to global extinction but might soon be uplisted in the future. CITES Appendix II.

NARCONDAM HORNBILL

Rhyticeros narcondami (Hume, 1873)

Taxonomy: Monotypic. Previously considered in genus *Aceros*. Previously considered conspecific with Papuan Hornbill, but geographical isolation combined with much smaller size support their treatment as two species.

Distribution: Endemic to Narcondam Island in north-east Andamans, India.



Description: 45-50 cm. Male 700-750 g; female 600-750 g. In structure and colouration it appears much like a miniature version of Papuan Hornbill. Adult male with rufous and female with all-black head and neck, juveniles of both sexes resemble male. The only hornbill within its range. The call is a loud, harsh *ka-ka-ka-ka* followed by a cackle, often 3-4 calling from the same tree. In alarm, calls *kraawk kok kok*.

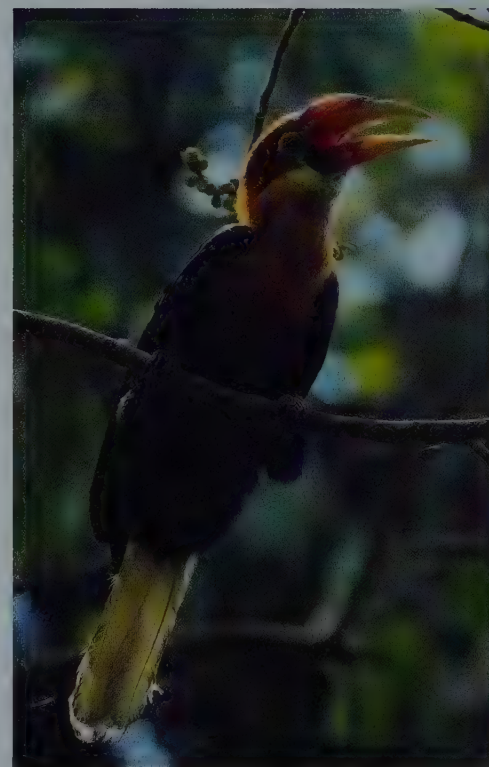
Ecology and habits: Found in evergreen and deciduous forest; occupies relatively open, mixed forest and dense bushes from the coast inland to the island's summit at 700 m elevation. It can be found all over the island except for the grassy slopes in the south and south-east. It is sedentary and feeds in fruiting trees, with 33 plant species identified as food, including figs, but with four non-fig species comprising 73% of foods when breeding. Such small animals as geckos, skinks, spiders, mantids,



Narcondam Island. Kalyan Varma

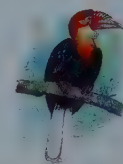
landcrabs and snakes are also eaten. Feeding parties of up to 50 birds have been recorded. Adults appear to roost as pairs below 255 m a.s.l., immatures roost 3-7 per branch at higher altitudes up in less ideal roosts, but roost sites change regularly.

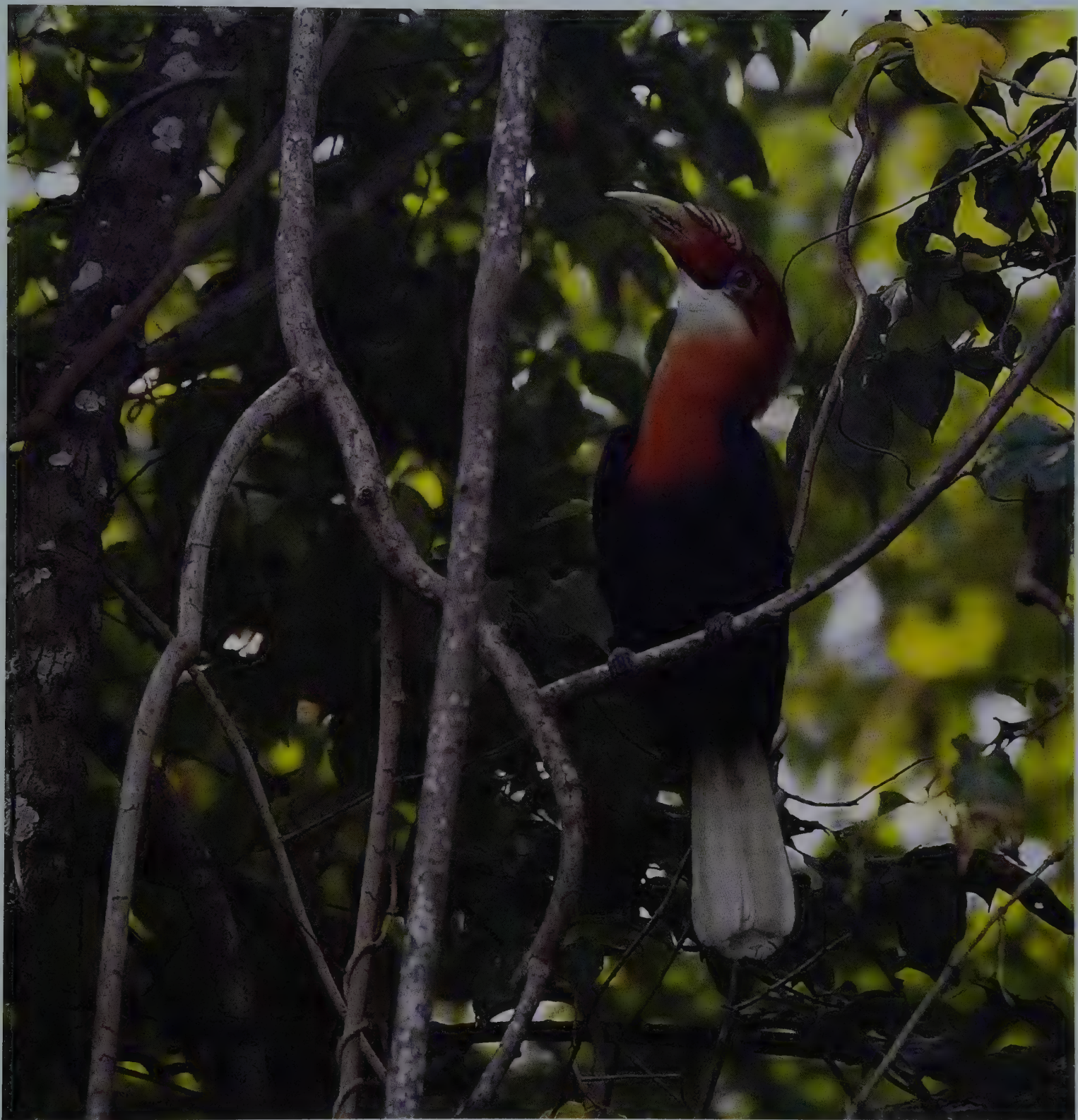
Breeding ecology: The breeding season starts in Feb-Apr. The nest is a natural cavity in a tree, 1.6-28 m above the ground; 40% of nests are between 10 and 15 m high. Seven tree species have been identified; one of the most popular trees is *Tetrameles insignis* (Datiscaceae) followed by *Sideroxylon* (Sapotaceae) and *Sterculia* (Sterculiaceae). 50% of the nests are in the trunk, the rest are at the end of a broken branch. 60% of nests are on a slope below 100 m elevation, 30% are between 100 and 200 m elevation, 10% are above 200 m. The pair does not seem territorially aggressive; alien adults are tolerated near the nest site; two neighbouring nests were only 23 m apart. The female seals the nest and the male feeds her by regurgitation with 10-93 fruit items per visit. The male often follows a regular flight path to the nest and will visit every 10-30 minutes. As for many hornbills in this genus, she moults her flight



Narcondam Hornbill; juvenile male. Kalyan Varma

Facing page: Narcondam Hornbill; adult male, at least six years old. Niranjana Sant





NARCONDAM HORNBILL

feathers while incarcerated. two eggs are laid, but there is no further information available on incubation and fledging periods. At one nest, the younger chick fledged successfully 10 days after the older one. At another nest, the female left the nest with the older chick and stayed with it, while the younger chick stayed for another five days in the nest before fledging successfully; during this time it was fed only by the male. Both the male and female feed the chicks after they have fledged.

Status: This hornbill has one of the smallest natural ranges of any bird species; the island where it lives is an extinct volcano covering only 6.82 km². It was probably never numerous within this tiny range; population estimates have varied from between 200 to 432 birds. In 2003 the population was estimated to be 320–340 birds, about 54 per km², out of which there were about 250 mature individuals. The population is threatened by habitat degradation from firewood collection, conversion to fruit orchards and especially grazing of goats from a police unit stationed on this politically sensitive outlier of Indian influence. Cyclones have caused the loss of some nesting trees and tsunamis are also a risk. Hunting for food previously resulted in an annual loss of 25–40 birds; the introduction of feral cats could also pose a danger. The island is a wildlife sanctuary; most of the disturbance has resulted from the police post established in 1969, but many of the conservation issues are being addressed today, and most of the goats have been moved off the island. A proposal in 2012 by the Indian coast guard to build a diesel generator-powered radar station on Narcondam was rejected. Due to its tiny world range and small and declining population size, this species is regarded as Endangered with global extinction. CITES Appendix II.



Narcondam Hornbill; male, at least four years old. Niranjana Sant



Narcondam Hornbill; male. Kalyan Varma



Narcondam Hornbill; young male with casque ridges developing. Niranjana Sant



Narcondam Hornbill; female, four years old. Kalyan Varma



Narcondam Hornbill; female. Niranjn Sant

An evolutionary puzzle

With its closest relative, the Papuan Hornbill, more than 2,000 km to the east, how did the Narcondam Hornbill end up on this isolated volcanic island less than 7 km² in area? Was it assisted by man? It is an evolutionary puzzle that has never really been explained.



Narcondam Hornbill; male looking down at female in nest cavity. Niranjn Sant



Narcondam Hornbill; male perched at nest.
Manoj Sharma

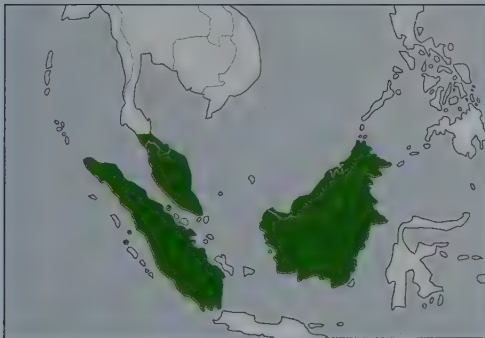
WRINKLED HORNBILL

Rhyticeros corrugatus (*Buceros corrugatus* Temminck, 1832)



Taxonomy: Monotypic. Previously considered in genus *Aceros*. Has in the past been considered conspecific with Wreathed and Rufous-headed Hornbills of the Philippines, but there are clear morphological differences and separate distributions. Birds from Asian mainland south to Sumatra and nearby islands have sometimes been separated as race *rugosus* on basis of larger size.

Distribution: South Thailand, Peninsular and Bornean Malaysia, and Kalimantan (Borneo) and Sumatra (including islands of Rupat and Payong) and Batu Island, Indonesia. Reports of records from SW Cambodia during the 1990s turned out to be erroneous (Setha, 2004).



Description: 65–75 cm. Male 1590 g. Male distinguished from male Wreathed Hornbill by black (not brown) crown and nape, white face and throat but stained with yellow from green oil, unbarred pouch white (not yellow), bill white but stained yellow with red at the base of upper mandible and brown wrinkle on lower mandible, and high red wrinkled (not wreath, creamy) casque. Both sexes have blue orbital skin (not red). The female is smaller, black with blue unbarred pouch; from female Wreathed Hornbill by yellow (not creamy) bill and plain casque (no ridges). Juveniles of both sexes resemble adult male in plumage but bill small, casqueless and pale yellow. The voice



Wrinkled Hornbill; male on a fruiting *Aglaia* sp tree, Borneo Tim Laman

is 1–3 coughing notes repeated at intervals, *sok sok sok* or *kourwou*, a softer version in flight. Also utters very harsh *pukekkek*.

Ecology and habits: Found in lowland rainforest, especially coastal swamp forest; usually below 30 m elevation but recorded up to 400 m a.s.l. Extends into selectively logged forest, but not secondary forest. It is not conspicuous and is usually seen more than heard. Feeds in the canopy of large emergent trees, mainly on fruits such as drupes; it is less attracted to figs than some other hornbills. It also takes some animal items when available. Breeding diet 67% fruit, with *Oncosperma horridum* (Arecaceae), *Litsea* and *Cinnamomum* (Lauraceae), *Aglaia* (Meliaceae), *Gymnacranthera* (Myristicaceae) and *Syzygium* (Myrtaceae) and figs predominant, and 33% animals, mainly insects and land snails but also feeds on reptiles,

frogs and bird's eggs. It searches through the foliage for food or occasionally picks off fruits in flight. Usually lives in pairs but sometimes in small flocks of up to 30 individuals. It moves extensively in search of fruiting trees on loud whooshing wing-beats, flying up to 10 km, high above the forest. It also attends communal roosts; has been known to cross open sea.

Breeding ecology: Eggs are laid in the beginning of the year, Jan–May. Rather aseasonal, in southern Thailand female seals in nest cavity in Feb–Mar and a chick fledges in early Jun. However, there were records from the same area where the females sealed between Jun–Jul and a chick fledged in Oct. The entire nesting cycle takes 95 days in this area. The nest is a natural cavity in a large forest tree, such as a large *Shorea cutisii* (Dipterocarpaceae), *Artocarpus* (Moraceae)

or *Syzygium* (Myrtaceae) near a stream; the female seals the nest entrance with droppings and food remains. The breeding ecology is little known in the wild; in captivity it lays 2-3 eggs, rarely 4, after a pre-laying period of typically 4-6 days, sometimes longer. Incubation is 29-35 days; the male brings food to the nest and feeds the female by regurgitation. The female leaves the nest together with the chick at fledging. The nestling period takes 65-73 days in captivity but only 35-54 days in the wild; the whole breeding cycle may last up to 124 days. Wild birds probably feed chicks up to at least 6 months after fledging and stay together in family groups until juveniles become independent and move to own immature flocks.



Wrinkled Hornbill; female feeding on a fig, Borneo.
Tim Laman

Status: Local and scarce throughout range, about 0.02-0.06 per km² in southern Thailand. Always uncommon, but now rare in Peninsular Malaysia, close to extinction in Thailand. Still reasonably common in parts of Borneo (Kalimantan) and in parts of Sumatra. Occurs in protected areas such as Gunung Leuser and Way Kampas NP (Sumatra), Danum Valley (Sabah, Borneo) and Taman Negara (Peninsular Malaysia). Population is declining due to rapid loss of forest in the Sundaic lowlands due to legal and illegal logging, land conversion and forest fires. During a national survey of hornbill populations in Thailand during 2004-2008, abundance indices from an average of 170 km line transects (53-293 km in four forest complexes of its range) were extremely low (0.01-0.03 bird per km) in two forest complexes. In the last two decades, only three nests confirmed in a rainforest of the Hala-Bala Forest Complex. In Brunei, abundance indices from line transect surveys of 2-17 km in six localities (every five years during 1991-2001) were 0.04-1.0 birds per km from five localities. Since this species seems to prefer large tracts of tall lowland forest and avoids degraded forest, IUCN warns of increased threat. Currently Near Threatened with global extinction. CITES Appendix II.



Wrinkled Hornbill, male in flight, Borneo. Con Foley



Wrinkled Hornbill, male at nest in a *Hopea* sp tree, Thailand.
Thailand Hornbill Project



Wrinkled Hornbill, male at nest, Thailand.
Thailand Hornbill Project

RUFOUS-HEADED HORNBILL

Rhyticeros waldeni (*Craniorrhinus waldeni* Sharpe, 1877)



Taxonomy: Monotypic. Previously considered in genus *Aceros*. Thought to form a superspecies with Knobbed Hornbill, Writhed Hornbill and Wrinkled Hornbill. Often considered conspecific with Writhed Hornbill, but differs in plumage and bare-part colours and there is no overlap in range.

Distribution: Philippine endemic. Occurs in the centre of the country in the Visayan Islands, where there are records from Negros, Panay and Guimaras.



Description: 60–75 cm. Somewhat similar to Writhed Hornbill with grossy black plumage, basal third of tail and its tip black, the rest white. Male has dark brown crown and hindneck; face and neck to upper breast is paler brown or chestnut; bill and casque is red to orange with dark lines across base of lower mandible; pouch and facial skin yellow, eye red-brown then yellow. Female is smaller, with all-black body, blue facial skin and pouch, and red-brown eye. The juveniles of both sexes resemble adult male, but the bill is smaller, paler and casqueless and the eye pale blue then yellow, not red-brown like both adults. Female all-black plumage appears at first moult after one year but both sexes only appear fully mature by 3–4 years old. The call is a series of single mellow barks; also a loud, nasal lamb-like bleating *wa-ha-ha*.



Rufous-headed Hornbill; male at nest. Nesting reports are rare for Rufous-headed Hornbill. Jon Hornbuckle

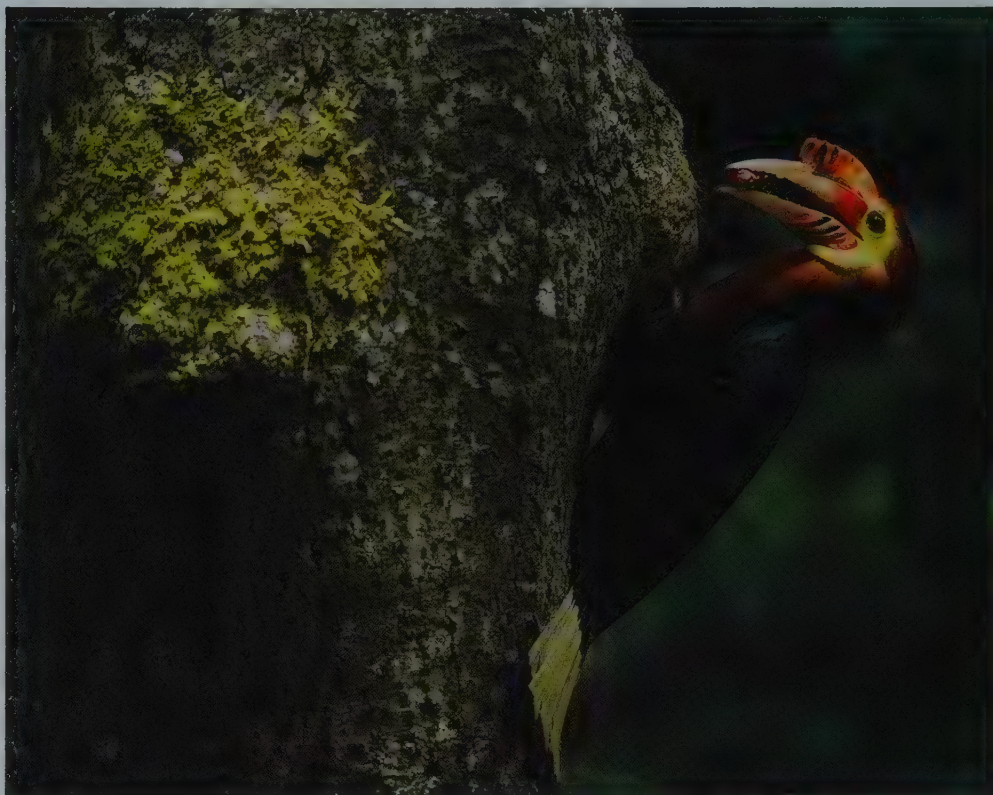
Ecology and habits: Occurs in lowland rainforest with closed canopy; found in both primary and selectively logged forest and has been seen in large trees in clearings. It ranges from the coast to 950 m elevation on Negros,

to 1,200 m on Panay. Probably sedentary, but will travel locally in search of food. Food is mainly fruits, including figs; in breeding season diet comprises almost exclusively fruits (98%), including fruit of Moraceae, Pterocarpaceae

and Icaenaceae; while the rest is invertebrate prey, including snails, beetles and caterpillars. Usually seen in small groups of up to four birds; rarely 25–30.

Breeding ecology: Little known. It seems to require larger trees for nesting than the sympatric Visayan Tarictic Hornbill and is aggressive to that species near nest. Two nests have been recorded, both 17 meters above ground; one in a natural cavity in a *Shorea polysperma* tree; the other in an old woodpecker hole. A clutch of 2, rarely 3, eggs are laid, probably in Mar; chicks have been collected from nests in May–Jul. 45–51 days pass from sealing in to first nestling heard, and 107–115 days for the whole nesting cycle. Female and chick(s) depart the nest at the same time.

Status: Scarce and threatened with global extinction. Due to almost complete habitat clearance on Guimaras, it is considered gone from that island. On Negros, forest cover has been reduced by 97%, on Panay by 94%; 90% of the forest cover left is above 1,000 meters elevation. Kinnaird & O'Brien (2007) found that out of a range area of 24,718 km² only 246 km² was optimal habitat. Hunting for food and the wildlife trade is a serious threat to remaining populations, and nests are regularly poached, according to one survey 50% of broods were affected until a volunteer nest guarding scheme reduced this to about 33% in the Central Panay Mountain Range, a strong-hold for this species. On Negros, it can still be found in Mount Canlaon Natural Park and North Negros Forest Reserve. There is a captive breeding program in progress for this species at the Mari-it Wildlife Conservation Park on Panay. Critically Endangered with global extinction; CITES Appendix II.



Rufous-headed Hornbill; male at nest. Tim Laman



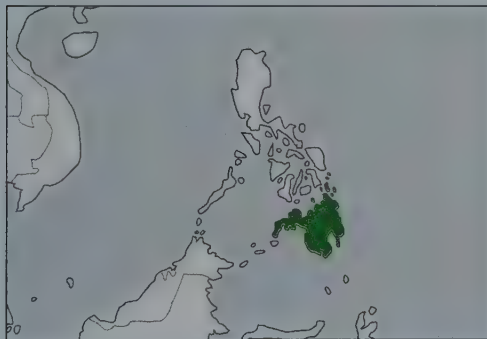
Rufous-headed Hornbill; adult pair in captivity, female on left. Ely Teehankee

WRITHED HORNBILL

Rhyticeros leucocephalus (*Buceros leucocephalus* Vieillot, 1816)

Taxonomy: Monotypic. Previously considered in genus *Aceros*. Thought to form a superspecies with Knobbed Hornbill, Wrinkled Hornbill and Rufous-headed Hornbill. Has in the past been treated as conspecific with Wrinkled Hornbill but differs markedly in morphology, and often considered conspecific with Rufous-headed Hornbill, but differs in plumage and bare-part colours and there is no overlap in range.

Distribution: Philippine endemic. Occurs in the south of the country on Mindanao and the nearby smaller islands of Dinagat, Siargao and Camiguin.



Description: 60–65 cm. Male 1012–1295 g. It is somewhat similar to Rufous-headed Hornbill; black with black-tipped white tail. Male has dark brown crown and hind neck; face and neck to upper breast are white but stained creamy by green oil; bill, casque, pouch and facial skin red. Female is smaller with all-black body except for orange-red bill, facial skin and pouch. Juveniles of both sexes resemble male in plumage, but the bill is small, paler and with no ridges and no casque. Generally rather silent; the call is a low *ung-geek-geek* and a hissing *phist*.



Writhed Hornbill; male, Mindanao. Nilo Arribas

Ecology and habits: Found in primary lowland rainforest, mainly below 500 m elevation but recorded up to 1,100 m. It travels widely across the forest to and from roosting sites in search of fruiting trees. The food is mainly fruits, and it prefers to feed high in the canopy of large forest trees. It also takes some insects on the wing by hawking. It is usually seen in pairs, although flocks might form, and old records report groups of up to 37 birds together. It often mixes with the sympatric but much larger Rufous Hornbill at prime feeding and roosting sites.



Writhed Hornbill; female, Mindanao. Nilo Arribas

Breeding ecology: Little known in the wild. Sealed nest recorded in Mar, fledged young in Jan. In captivity it lays 2 eggs; female emerges with chicks after a nesting cycle of 92 days.

Status: Poorly known; it might still be fairly common in suitable habitat, but numbers are believed to be declining due to logging and forest clearance for agriculture. It is also subject to pressure from hunting and trapping for wildlife trade. Given its dependence on primary undisturbed lowland forest, it is currently considered Near Threatened with global extinction. CITES Appendix II.



Writhed Hornbill; male. Pete Morris



Writhed Hornbill; female, Mindanao. Nilo Arribas



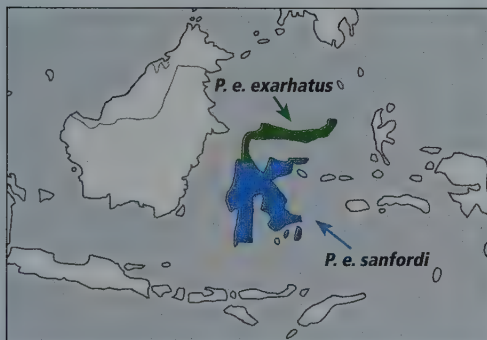
Writhed Hornbill; male (top) and female (above). Pete Morris

SULAWESI TARICTIC HORNBILL

Penelopides exarhatus (*Buceros exarhatus* Temminck, 1823)

Taxonomy: Always treated as a separate species from its Philippine congeners. Two subspecies recognised: *P. e. exarhatus* occurs on north Sulawesi and Lembeh Island; *P. e. sanfordi* has ridges on the lower mandible of its bill and occurs on south Sulawesi and the islands of Muna and Butung.

Distribution: Endemic to Indonesia; occurs on Sulawesi and some adjacent islands.



Description: 45 cm. Female 370 g. Small-sized and entirely black hornbill, except for male's white face stained with yellow, possibly from preen oil. Female is smaller with all-black plumage and base of bill. Juveniles of both sexes like adult male, but almost casqueless bill smaller and dark yellow. Adult facial colours develop when juvenile 80–105 days old. The tarictic group of hornbills (genus *Penelopides*) are named as an onomatopoeic reference to their call, but the frequent call of this species is a piercing four-syllabic *kerrekerre kerrekerre*.

Ecology and habits: Occurs in primary rainforest, mainly in the lowlands to 650 m elevation, but has been recorded to 1,100 m. Extends from mature forest into secondary forest and more open areas nearby. Fruit is main food (85%) and some animal prey, mainly invertebrates. 34 different species of fruiting trees and shrubs have been identified as food



Sulawesi Tarictic Hornbill; *P. e. sanfordi*, male, southern Sulawesi. Pete Morris

sources. This small hornbill moves inside or just below the canopy of the forest in small family groups. It is apparently sedentary and territorial; has been reported to chase the sympatric but much larger Knobbed Hornbill. The home range when breeding has been measured as 0.7–1.4 km²; another survey found an all-year home range for a group at 1.5–2.0 km². It lives in groups of up to 20 individuals; it is believed that only the dominant pair will breed, with the rest of the group acting as helpers.

Breeding ecology: This species is a co-operative breeder; groups of 2–10 birds, average 4, will attend to one nest; adult helpers can be both male and female. The nest is a natural cavity or an old woodpecker hole in a large forest tree, including sites used previously by Knobbed Hornbill, but more evenly spaced resulting from group territoriality. Majority of nests were in deciduous forest (42%) of diverse species; at Tangkoko Batuangus Nature Reserve three nest trees were positively selected in *Alstonia ranvolfia* (Apocynaceae), *Diospyros rumphii* (Ebenaceae) and *Homalium foetidum* (Flacourtiaceae), whereas at Bogani Nani Wartabone NP nine nests were in seven species with *Tetrameles nudiflora* (Datisceae) dominant. All nests from these two sites were 7–32 m above the ground. The egg-laying takes place in Apr to Oct, the female sealing herself into the



Sulawesi Tarictic Hornbill; nominate race, female, northern Sulawesi. Daisy O'Neill

nest, and the male and some helpers feeding her and later the chicks with regurgitated food. 2 eggs are usually reported in the wild. Data from captivity show that up to 4 eggs may be laid; first egg 9 days after the female is sealed into the nest, the rest at two-days intervals. Incubation in captivity was 28–30 days. The two chicks fledged after 55–70 days; the female left the nest 24–32 days before the chicks.

Status: This species is still locally common, and it occurs in most protected forest reserves on Sulawesi Island such as the popular Bogani Nani Wartabone NP, Lore Lindu NP and Tangkoko Batuangus Nature Reserve. Three zoos outside Indonesia keep and breed the species (in England, the Netherlands and San Diego, USA). The wild population has not been estimated. However, suitable habitat on Sulawesi has been shrinking rapidly and at an accelerating rate, especially in the southern parts of the island; the loss of large forest trees suitable for nesting sites is particularly detrimental to this hornbill. It is also under pressure from hunting and capture for the bird trade. The wild population is believed to be declining rapidly, and the species was uplisted in 2012 from Least Concern to Vulnerable to global extinction. CITES Appendix II.

Facing page: Sulawesi Tarictic Hornbill; nominate race, male feeding on *Dysoxylum* sp fruit, Temboan Hill, northern Sulawesi. Bjorn Olesen



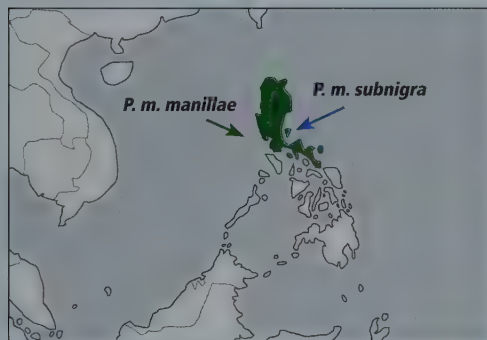
LUZON TARICTIC HORNBILL

Penelopides manillae (*Buceros manillae* Boddaert, 1783)



Taxonomy: Has been treated as conspecific with Philippine congeners. Forms a superspecies with Visayan, Mindanao, Mindoro and Samar Tarictic Hornbills and all five were previously considered conspecific. Two subspecies recognised: *P. m. manillae* occurs on Luzon, Marinduque, Catanduanes and adjacent small islands; the larger and darker *P. m. subnigra* occurs on Polillo and Patnanongan islands.

Distribution: Endemic to the Philippines; occurs on the island of Luzon and some adjacent islands.



Description: 45 cm. Male 395–470 g; female 470–475 g. Small-sized hornbill; male has creamy white head and underparts; upperparts, vent and cheeks dark brown; tail black with pale brown band; bill is prominently ridged; pink facial skin and red eyelids. Female all-black except for pale tail band and blue around eyes and gular area; juveniles like respective adults except for smaller dull brown bill. The call has been described as a loud, clear, short squeak like a child's squeeze-toy or a trumpeting *toot-toot, tut-tut*.

Ecology and habits: Occurs in primary dipterocarp rainforest and riverine forest, mainly in the lowlands up to 900 m elevation. Exposed to severe habitat destruction, but *P. m. subnigra* tolerates disturbance and adapts



Luzon Tarictic Hornbill; adult pair, male on left, Luzon. Con Foley

to secondary growth and agro-forests. It feeds on a wide range of fruits and will visit single fruiting trees in nearby grassland to feed. The food is mainly fruits, of at least 36 indigenous and cultivated plant species, but it prefers indigenous species, for instances Moraceae (*Ficus* spp, *Artocarpus*), Buseraceae (*Canarium* spp), Lauraceae (*Litsea* sp, and *Cinnamomum* sp), Meliaceae (*Dysoxylum* spp) Myrtaceae (*Syzygium* spp), Arecaceae (*Cocos cumingii*, *Livistonia rotundifloriae*, *Pinanga insignis*); also takes insects (beetles) and other small animal food (bird eggs and nestlings, lizards). It appears

to be sedentary and territorial; moves in small groups of up to 15 individuals.

Breeding ecology: This species is territorial and believed monogamous, possibly cooperative when breeding. The nest is in a natural cavity in a large forest tree. Nesting takes place during the short dry season Mar–Jun; on Polillo, two nests of *P. m. subnigra* were found in *Shorea* sp, one at >20 m and the other at <2 m above the ground in a dipterocarp

Facing page: Luzon Tarictic Hornbill; male on a fig tree, Luzon. Con Foley



LUZON TARICTIC HORNBILL

forest; one nest on Patnanungan was in *Alstonia macrophylla* (Apocynaceae). Nesting behaviour is not yet well studied. Usually 2-3, rarely 4 eggs are laid in Mar-Apr; in captivity eggs were laid 1-5 days apart. Incubation period is 28-31 days; the male will feed the female and later the chicks with regurgitated fruits and animal food. Immature birds from previous season have been observed as helpers at the nest. The fledging period is 50-65 days; the female will emerge together with the chicks.

Status: The subspecies *P. m. manillae* is still fairly numerous on Luzon, although less than 10% of its range is optimal habitat. The population has not been estimated but is believed to be well over 10,000 birds. It occurs where large tracts of rainforest still remain such as in Sierra Madre and Quezon NPs. Due to forest clearance, the species has declined in numbers on the smaller islands; *P. m. subniger* is believed to be down to 1,000 birds on Polillo and only 50 on Patnanongan, but has received considerable conservation attention, including an annual Tarictic festival. Although population is declining due to habitat loss and hunting pressure, this species is not currently threatened with global extinction. CITES Appendix II.



Luzon Tarictic Hornbill; female, Luzon. Con Foley



Luzon Tarictic Hornbill; female on a fig tree, Luzon. Con Foley



Luzon Tarictic Hornbill; male in fig tree, Luzon. Con Foley

MINDORO TARICTIC HORNBILL

Penelopides mindorensis (Steere, 1890)

Taxonomy: Monotypic. Has been treated as conspecific with Philippine congeners. Forms a superspecies with Visayan, Luzon, Samar and Mindanao Tarictic Hornbills and all five were previously considered conspecific.

Distribution: Endemic to the Philippines; occurs only on the island of Mindoro.



Description: 45 cm. Small-sized hornbill; appears like Visayan Tarictic Hornbill; male has pink (not blue) facial skin and lacks black base on bill. Female like male except smaller with blue facial skin; this is the only species in the genus where the female resembles the male and is not almost entirely black. Juvenile resembles adult of same sex except for smaller stripeless bill. The voice has been described as much deeper and less trumpet-like than Visayan Tarictic Hornbill; a weak note or a series of *tar-ic-tic*.

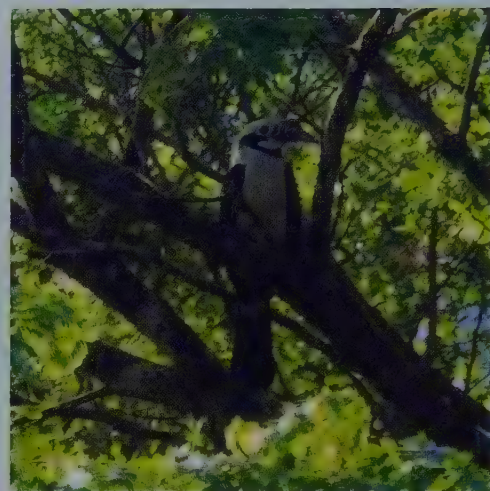
Ecology and habits: Found in primary rainforest, as well as secondary forest, forest edge and agro-forests, mainly in the lowlands that retain *Ficus*, *Artocarpus* (Moraceae), *Canarium* (Burseraceae), *Syzygium* (Myrtaceae) and *Dysoxylum* (Meliaceae) fruiting trees, but recorded up to 1,000 m elevation. Resilient to typhoon damage to its habitat, it visits tiny forest patches and even isolated fruiting trees for feeding, but



Mindoro Tarictic Hornbill; female, Mindoro.
Bram Demeulemeester

is probably reliant on larger tracts of closed-canopy forest nearby for breeding sites. Feeds on fruits, mainly figs; possibly also some insects. It appears to be sedentary and territorial; it is usually seen in pairs or in small flocks of up to 20 individuals.

Breeding ecology: It is claimed to use dipterocarp trees as a nest tree. Female found to be in breeding condition in May; there is no other data available, but studies are urgently needed to assist conservation.



Mindoro Tarictic Hornbill; male, Mindoro. Greg Metro

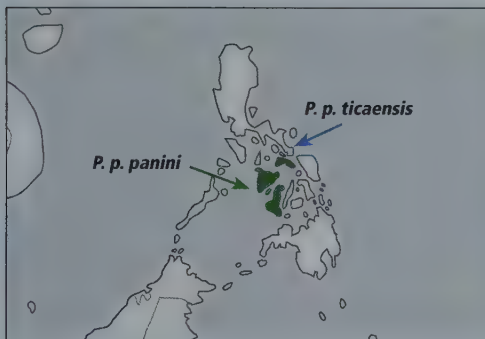
Status: This species is found in the lowland forest up to 1,000 m a.s.l. of only one island, Mindoro. The island is 10,572 km², but forest cover was estimated at only 120 km² in 2007 and declining, due to encroaching slash-and-burn cultivation, logging, illegal firewood collection and land-erosion linked to deforestation. This hornbill was formerly widespread and abundant and was still considered fairly common in the 1970s; it has declined rapidly since. Since 1990 there have been observations from just five localities, with a maximum count of 20 birds at Mount Siburan in 1994, the largest tract of forest on the island. However, 183 observations were recorded from 5 sampling sites in this area during fieldwork in 2005. Remnant populations in fragmented forest patches may exist elsewhere on Mindoro, such as in the small Mount Iglit-Baco NP, but more fieldwork is needed. The total world population is believed to be more than 250 but less than 1,000 individuals and declining, due to habitat loss and also some hunting for food; in view of this, this species is regarded as Endangered with global extinction. CITES Appendix II.

VISAYAN TARICTIC HORNBILL

Penelopides panini (*Buceros panini* Boddaert, 1783)

Taxonomy: Has been named as the inclusive species and treated as conspecific with Philippine congeners. Forms a superspecies with Luzon, Mindanao, Mindoro and Samar Tarictic Hornbills and all five were previously considered conspecific. Two subspecies recognised: *P. p. panini* occurs on Panay, Masbate, Sicogon, Pan de Azucar, Guimaras and Negros Islands; the larger *P. p. ticaensis* occurred only on the 334 km² Ticao Island.

Distribution: Endemic to the Philippines; occurs on the Visayan group of islands.



Description: 45 cm. Female 370 g. Small hornbill; male is yellowish-white with pale rufous belly, vent and proximal tail feathers; upperparts, tip of tail and cheeks black; bill black and prominently ridged with yellow, and facial skin creamy blue. Female all-black except for creamy tail and blue facial skin, the chin patch able to rapidly pale or darken; juveniles like respective adult in plumage, except for smaller more reddish smooth bill. Mature by 2-3 years old. Can often be located and identified by its voice; the call is a noisy and rapid *teerik-tik-tik-tik*; in flight also a quick and agitated *aunk-aunk-aunk*.

Ecology and habits: Occurs in primary rainforest, mainly in the lowlands to 1,100 m elevation, deforestation may have pushed



Visayan Tarictic Hornbill; male, Panay Island. The female is similar to female Mindanao Tarictic Hornbill. Lorenzo Vinciguerra



Visayan Tarictic Hornbill; nominate race, male. Tim Laman

it higher to 1,500 m. Extends into secondary forest and isolated fruiting trees nearby to feed. The food is mainly fruits (approximately 86%), particularly lipid-rich fruits, including *Myristica philippinensis* and *M. glomerata* (Myristicaceae), and *Chisocheton cumingiana* (Meliaceae) with some invertebrate prey as well. It appears sedentary and territorial; feeds inside or below the forest canopy and along the forest edge.

Breeding ecology: Breeding season commences in Mar-Apr and lasts into Jun. The nest is a natural cavity in a live or dead tree; out of 22 nests recorded, height above ground

varied from 2 to 19.5 m, mean 11 m. Also, but less often, nests are found in rock holes. The female will seal the nest hole with wood chippings and food remains. 2-4 eggs are laid in Mar-Apr, incubation period is still unknown but believed to be 30-35 days or 38-46 days from sealing in to first chick heard. This species breeds in pairs, possibly sometimes in a co-operative manner with 2-3 birds involved, less often 8 and rarely up to 12 birds. The male feeds the female and later the female and chicks at the nest with regurgitated food; the female and the oldest chick will leave the nest together after a fledging period of about 55-58 days, other chicks re-sealing the nest and emerging up to 11 days later; the total nesting cycle is about 95-105 days. Mature by 3 years old, but successful breeding only by 4-6 years old.

Status: The decline of this species has been dramatic and catastrophic. Kinnaird & O'Brien (2007) estimated that out of a range area of 27,910 km² only 355 km² was optimal habitat. Due to almost complete forest clearance on Ticao Island the subspecies *P. p. ticaensis* is the first distinctive hornbill population to suffer this fate; and *P. p. panini* is now thought to have disappeared or almost disappeared from all the smaller islands, leaving only Panay and Negros with viable populations. On Panay, it is rare except within the proposed Central Panay Mountains NP where it may be fairly common. On Negros it has declined rapidly; but can still be found in Mt Canlaon NP and the North Negros Forest Reserve. Current population could be below 1,000 individuals. Even so, hunting and trapping of both adults and young on Negros is still rampant; birds have been reportedly sold for as little as US\$1. In view of this, the species is regarded as Endangered with global extinction. Captive breeding has been successful on both Panay and Negros and released birds have bred themselves. CITES Appendix II.



SAMAR TARICTIC HORNBILL

Penelopides samarensis (Steere, 1890)

Taxonomy: Monotypic. Has been treated as conspecific with Philippine congeners. Forms a superspecies with Visayan, Luzon, Mindoro and Mindanao Tarictic Hornbills, closest to the latter but all five previously considered conspecific.

Distribution: Endemic to the Philippines; occurs on the islands of Samar, Calicoan, Leyte and Bohol.



Description: Small hornbill; appears like Mindanao Tarictic Hornbill with which it was considered conspecific until recently, but this species is slightly larger, and the male has light rufous vent; both sexes have less black on tail. The voice in one recording is a rapid, continuous chuckling *kok-kok ...kok-kok-kok*.

Ecology and habits: There is no information available but habits may be similar to its congeners.

Breeding ecology: No information available, but must be presumed to be similar to congeners.

Status: This species is reported to be common on Samar and probably on Leyte. It occurs in Rajah Sikatuna NP on Bohol. The population has not been estimated but is believed to be well over 10,000 birds. Although the population is declining due to habitat loss and hunting for food, this species is not currently threatened with global extinction. CITES Appendix II.



Samar Tarictic Hornbill; female. Jon Hornbuckle



Samar Tarictic Hornbill; male. Jon Hornbuckle



Samar Tarictic Hornbill; adult pair, male above, Bohol. Nilo Arribas

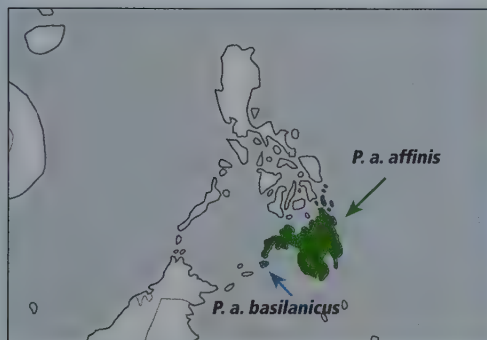
MINDANAO TARICTIC HORNBILL

Penelopides affinis (Tweeddale, 1877)



Taxonomy: Has been treated as conspecific with Philippine congeners. Forms a superspecies with Visayan, Luzon, Mindoro and Samar Tarictic Hornbills and all five previously considered conspecific. Two subspecies recognised: *P. a. affinis* occurs in Mindanao, Dinagat and Siargao; *P. a. basilanicus* is endemic to Basilan Island.

Distribution: Endemic to the Philippines; occurs on the island of Mindanao and some smaller adjacent islands.



Description: 45 cm. Male 456–554 g; female 394–514 g. Small-sized hornbill; male has creamy white head and underparts; upperparts, vent and cheeks dark brown; tail pale with black tip; bill is prominently ridged with black base and pale blue facial skin. Female all-black except for pale tail with black tip and base, and blue facial skin. *P. a. basilanicus* has less black on tail base and lacks black base on bill. Juveniles of both sexes like adult male in plumage, except for smaller brown bill. The call has not been described.

Ecology and habits: Found in primary rainforest as well as secondary forest and forest edges, from the lowlands up to 900 m elevation. The food is fruits and seeds as well as some animal food such as lizards and beetles. It appears to be sedentary and



Mindanao Tarictic Hornbill; male, Mindanao. Paul Noakes



Mindanao Tarictic Hornbill; female, Mindanao. Nilo Arribas

territorial; it moves inside and just below the canopies of the forest; usually seen in pairs or in small groups of up to 12 individuals.

Breeding ecology: This species is little known. Breeding appears to take place in Apr-May. In captivity, both sexes seal the nest cavity; 3 eggs were laid; incubation was 25 days and nestling period 47-54 days.

Status: There are still large tracts of habitat available for this hornbill on Mindanao, less so on the smaller nearby islands. Kinnaid & O'Brien (2007) found that out of a range area of 120,002 km² some 6,307 km² (about 5%) was optimal habitat. The population has not been estimated but is believed to be well over 10,000 birds. Although the population is declining due to habitat loss and hunting pressure, this species is not currently threatened with global extinction. CITES Appendix II.



Mindanao Tarictic Hornbill; male, Mindanao. Greg Metro



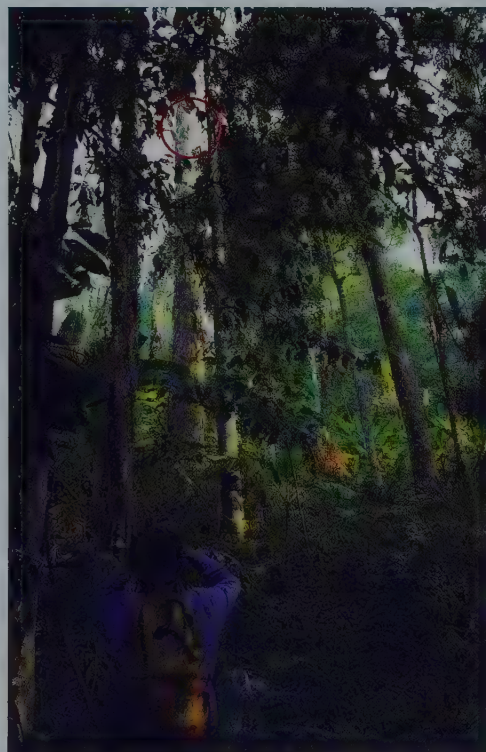
Mindanao Tarictic Hornbill; male, Mindanao. Nilo Arribas

THREATS AND CONSERVATION

Competition between animal and plant species on Earth has probably existed since time immemorial. However, relatively few species were affecting others to the extent that they were driven to extinction, until *Homo sapiens*, the 'wise human', came along. Previously, most serious threats came from such natural processes as continental drift, volcanism, asteroid collision and climatic change, events outside the scope of our effective intervention. But since the evolution of Man a couple of hundred thousand years ago, a variety of species have been driven to extinction, initially mainly by hunting, but subsequently more by habitat and climate alteration. Fortunately for hornbills, these man-made threats are ones we should be able to ameliorate to conserve any species that they affect.

Hornbills and Man

Hornbills coexist with a wide range of human cultures across their Old World distribution. From San hunter-gatherers of southern Africa, closest geographically and culturally to the heart of human origins and reliant originally on energy only from the Sun and fire, to the patchy amalgam of westernised societies, concentrated in cities with all the trappings of technology, still reliant on energy from the Sun but augmented massively by fossil fuels. In between stretch a complex mosaic of rural, subsistence and commercial cultures, beliefs, ventures and ambitions. Relatively few of these cultures consciously acknowledge hornbills, and even fewer interact positively with them, so it seems unlikely therefore that conservation of hornbills will proceed from the efforts of these majorities. However, since hornbills are obvious and noisy members of the habitats that they share with humans, a number of species have the potential to serve



To be able to help the hornbills we need to know more about them. Here, Pilai Poonswad studies a nest of Rufous-necked Hornbill (circled), and on another location, her staff from the Thailand Hornbill Project has gained access to a nest for a nest-improvement effort. Morten Strange, Thailand Hornbill Project

as 'flagship' species for the conservation of those habitats and the organisms that share them, in addition to their vital role as dispersal agents of seeds of plants, which has had them nick-named 'Farmers of the Forest'.

Conservation proceeds on many fronts, from concern over the welfare of individuals, such as safeguarding the nest site of a breeding pair or rescuing an injured bird, to managing the health of populations, which aims to stabilise or increase overall numbers rather than concentrate on the fates of individuals. A healthy population is one in which, over a given time period, the number of recruits being raised to independence balances out or exceeds the number of deaths. Healthy populations have some resilience to threats,



due to the surplus of younger individuals that accumulate, as they await maturity and search for vacancies in the adult breeding population. Once any threat eliminates that surplus, or even more dangerously the successful breeding adults, the population will start to decline. The rate of decline is determined by the severity of those threats, and it might carry a risk of an exponential plunge towards extinction. Just like one's bank balance after cessation of income! Obviously, the smaller in size the endangered population becomes, the more the fate of and attention to individuals becomes important. Undoubtedly, the most effective conservation, in terms of time, energy and expense, comes from successful management of healthy stable populations.

Food and nests

The two primary requirements of any bird population for survival are an adequate supply of food and safe nesting sites. For hornbills, as far as food is concerned, this translates into habitats that support plentiful supplies of small animals and/or fruits. These food supplies need to be available throughout the year, in both quantity and quality, either within a confined area, for species that are territorial throughout the year, or as a series of patches that can be tracked by hornbills during their breeding and non-breeding seasons. As a rule, small animals are most plentiful in natural habitats, with their diverse vegetation and ecological niches that support a wide variety of species. Occasionally brief patches of abundance do appear in natural habitats, or even in man-made habitats, such as irruptions of locusts, caterpillars or rodents, normally termed pest outbreaks; those

can provide temporarily abundant food for hornbills. For fruits, most frugivorous hornbills feed on the wide variety of wild fruits found in natural environments, although some species will obtain part of their food from cultivated and/or non-indigenous species if available, such as oil-palm fruits, originally natural to the forests of Africa but now grown in plantations across the tropics, or guavas, papayas or peanuts. What all this means for conservation of hornbill foods is that preservation of natural habitats, with their diversity of food sources, becomes a primary goal.

Nest sites for hornbills depend on the availability of natural cavities, most often in trees, but occasionally also in rock faces and rarely in earth banks. Hornbills are unable to excavate their own cavities, unlike birds such as woodpeckers or barbets, and so any factors that reduce availability of cavities are a

problem for hornbill conservation. Hornbills will use cavities excavated, modified or vacated by other animals and so, in part, the abundance and health of other cavity-using animals in hornbill environments is one of the important factors that determine what nest sites are available to them. For conservation, a positive side to hornbill flexibility in choice of nest sites is that, in some instances, the repair or creation of nest sites can be employed in population management.

Habitat loss

Alteration of habitats by human activity, which makes them less suitable for hornbills, is the principal threat to all species. Tropical forests are the hornbill habitat most altered, initially through clearing for slash-and-burn or swidden subsistence agriculture, and latterly for commercial logging for timber, followed



The first nest has been improved by Thailand Hornbill Project staff, and a Great Hornbill pair has accepted the home improvement attempt; the other photo shows another Great Hornbill accepting an artificial nesting box built from scratch. Thailand Hornbill Project

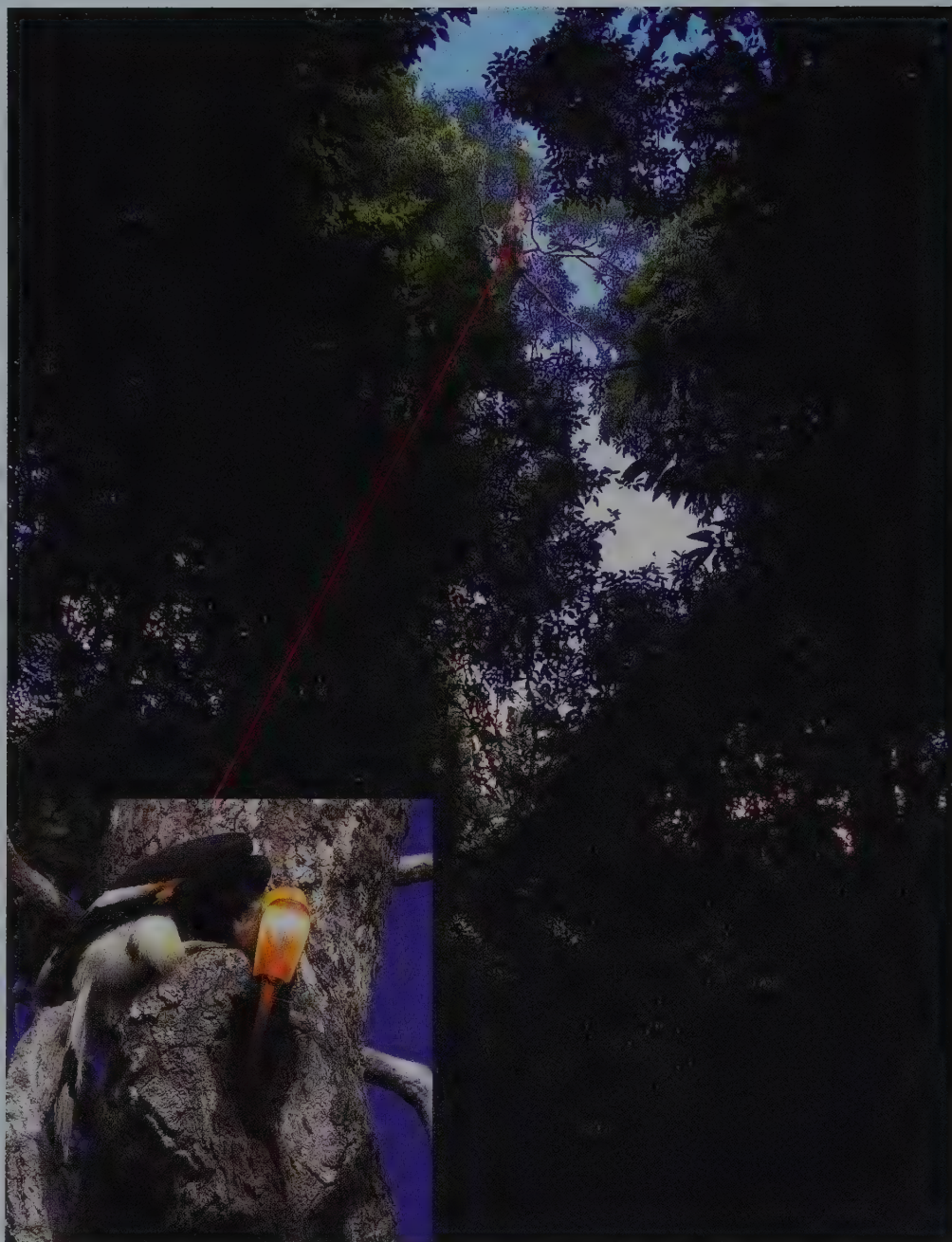
THREATS AND CONSERVATION

by clearance for crops such as oil-palm and para-rubber plantations or cereal pastures. The effects of these alterations to forest habitats on hornbills are best illustrated by a table of the species classified as under threat of extinction by the International Union for the Conservation of Nature (IUCN), using its stringent criteria for inclusion in the so-called 'Red Data' lists for animals and plants. The table below lists all 57 taxa of hornbills currently recognised as full species and their global conservation status. Individual countries also develop Red Data lists, using the same criteria but confined in area within the boundaries for which they are responsible; these national lists often report higher levels of regional threat than within the total range of a species.

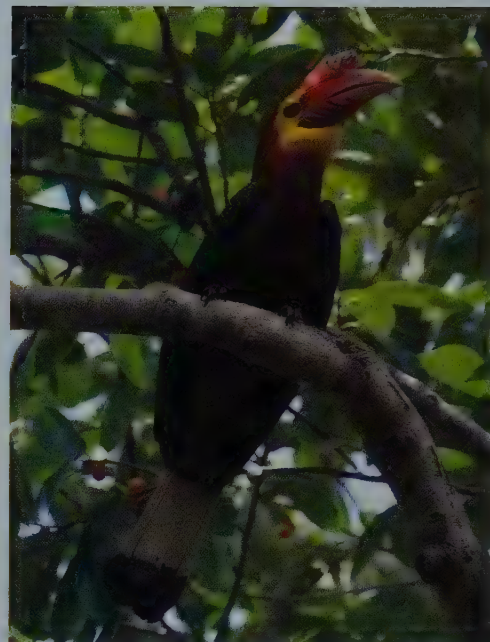
Currently (2013), 25 out of 57 species are either globally threatened or near threatened with extinction, i.e. about 44%. Most are in Asia, and all but one have forests as their



To find out more about the ecology of hornbills, researchers make use of technology, such as this GPS transmitter that they attached to a male Wreathed Hornbill. Narong Suwannarong



To study the hornbills, the Thailand Hornbill Project field staff builds hides of sticks and leaves on the forest floor near the located nest trees. This is the view from one of those hides, as well as a close-up shot (inset) with a telephoto lens from exactly the same place. Morten Strange



There are two Critically Endangered hornbills in the world, and both only occur in the Philippines; in this artwork named *Sunset* by Ludo Collingwood, they are both featured together. In real life they do not co-exist; the Rufous-headed (right, top) only occurs on two islands, Negros and Panay; the Sulu hornbill (right, above) is in fact extinct on Jolo (Sulu) Island and today it only occurs with certainty on Tawi-Tawi. Ludo Collingwood, Lorenzo Vinciguerra, Desmong Allen

THREATS AND CONSERVATION

favoured habitat, the only exception being the Southern Ground-hornbill, a savanna species only recently uplisted from Near Threatened to Vulnerable due to various increasing human pressures, including habitat alteration. The areas where forests are most threatened are where there is commercially valuable timber and/or a high density of people, and the hornbills most at risk are those with relatively small total ranges and/or large body sizes that means they live at relatively low densities with small total populations per unit area.

As a country, the Philippines, with ten hornbill species, all of them endemic, best illustrates the severity of these trends towards extinction. It is a country comprised of many islands, with different hornbill species on various forested islands or archipelagos, and some hornbills of medium to large size. Seven

out of the ten species are threatened or near threatened with extinction, including the only two Critically Endangered hornbill species in the world. Only three small species on some of the larger islands are of Least Concern, while on Ticao Island the local race or subspecies of the Visayan Hornbill *P. p. ticaensis* has the dubious distinction of being the first distinctive population of a hornbill to have gone extinct in the world.

As a continent, Asia has by far the most threatened hornbill species, 22 out of 25. This is partly because all Asian species inhabit forest, many Asian countries include or are comprised

of islands, and there are many areas of high human population density and development. A number of the most threatened hornbill species are from restricted island populations, others are from areas of the Asian mainland with high human densities and development, and a considerable number are from lowland forest habitats that are also best for logging and agriculture. In contrast, only three hornbill species are classified as threatened on the undivided land mass of the African continent. Those are the Southern Ground-hornbill of very large body size and atypically Vulnerable in the savanna habitat, and the Yellow-casqued and



Apart from habitat conversion, the biggest threat to hornbill survival as a group is hunting and poaching; this magnificent Black-casqued Hornbill ended up for sale as a piece of road-side bush-meat in Cameroon.

Kris Blachowiak



With a population of only some 250 mature birds, and a world distribution range of less than 7 km², this Narcondam Hornbill is the only hornbill species together with two species from the Philippines in the Endangered category.

Manoj Sharma



During the update in 2012, IUCN uplisted four hornbill species to Vulnerable to global extinction; (clockwise from top left) Brown-cheeked and Yellow-casqued in Africa from Near Threatened, and Knobbed and Sulawesi Tarictic in Indonesia from Least Concern. Jon Hornbuckle, Nik Borrow, Paul Noakes, Leslie Fung

Brown-cheeked Hornbills that emphasise the rapid global declines in lowland rainforests by being Vulnerable in West Africa.

What to do

Efforts to conserve hornbill populations and ameliorate the threats they face take many forms. The most effective approach is to protect the largest possible tracts of natural habitat. This explains in part why all but one of the African savanna species are of Least Concern (i.e. thanks to the extensive conservation areas created for big-game mammal species), and why so far only two West African forest species are Vulnerable (i.e. due to belated timber extraction on the continent compared to Asia). Where large tracts of unspoiled habitat no longer exist, as in most Asian countries, whatever is left has to be protected, if the hornbills are to survive. Lowland or hilly rainforest must be of sufficient size to support viable and inter-connected populations of the larger low-density species, such as Great, Rhinoceros, Rufous and Helmeted Hornbills. Finding sufficient areas of habitat to protect becomes especially acute on islands.

It is not surprising, therefore, that some of the most intense, innovative, intrusive and expensive conservation interventions have been developed and applied in Asia. Genetic studies in Thailand and the Philippines have begun to assess the extent to which forest fragmentation has split hornbill populations. The Thailand Hornbill Project repairs nest cavities in trees in various areas, or supplements them with artificial cavities, considerably boosting the numbers of chicks fledged each year. It has also pioneered converting hornbill and timber poachers into wildlife guardians and eco-guides. Cash-flow for this comes from national and international supporters who adopt a nest annually and receive regular

THREATS AND CONSERVATION

reports on their nest, an approach now being duplicated in Assam, India. The most intrusive interventions have been in the Philippines, where some of the rarest hornbills are bred in captivity for release back into the wild to augment their dwindling populations; and in South Africa, where wild-harvested and captive-bred, redundant, second-hatched chicks of Southern Ground-hornbills are hand-reared for re-introduction into those parts of their range from which they were extirpated. Even Singapore, populous economic hub that it is, has assisted a naturally occurring breeding population of Oriental Pied Hornbills on the offshore island of Pulau Ubin by re-introductions and artificial nests on the main island, and has plans to return the locally extinct Rhinoceros Hornbills to its avifauna.

Hornbills are among the most charismatic and biologically interesting birds in the habitats where they occur, and there is still time to conserve and enjoy the majority of species in their natural environments. Where threats to their existence have become severe, there are approaches and techniques that can delay and hopefully reverse their slide towards extinction, provided that there is awareness of their presence and problems, compassion for their special place on Earth, and the national and international will to conserve them. ■

Hornbill species ranked by their IUCN Red Data endangerment, with indications of their basic habitat requirements, body size and region of occurrence. Species whose populations may be uplisted to a less secure conservation rank due to increasing threats (*) or taxonomic splitting into separate species (**) are indicated. See individual species texts for further details of biology and distribution, and of the particular threats that each species faces.

Hornbill species	Habitat preference	Basic body size	Region of occurrence
Critically Endangered (50% probability of extinction within 5 years)			
Sulu	Forest, small islands	Medium	Asia, Philippines
Rufous-headed	Forest, small islands	Medium	Asia, Philippines
Endangered (20% probability of extinction within 20 years)			
Mindoro Tarictic	Forest, 1 island	Small	Asia, Philippines
Visayan Tarictic*	Forest, small islands	Small	Asia, Philippines
Narcondam	Forest, 1 island	Small	Asia, India
Vulnerable (10% probability of extinction within 100 years)			
Palawan	Forest, small islands	Medium	Asia, Philippines
Rufous-necked	Forest, hill	Large	Asia, mainland
Plain-pouched	Forest, lowland	Large	Asia, mainland
Knobbed	Forest, islands	Large	Asia, Indonesia
Brown-cheeked	Forest, lowland	Medium	Africa, West
Sulawesi Tarictic	Forest, island	Small	Asia, Indonesia
Yellow-casqued*	Forest, lowland	Large	Africa, West
Sumba*	Forest, 1 island	Small	Asia, Indonesia
Southern Ground	Savanna	Very large	Africa, East/Central/South
Near Threatened (declining, but locally and at a relatively slow rate)			
Rufous**	Forest, islands	Very large	Asia, Philippines
Writhe	Forest, islands	Large	Asia, Philippines
Malabar Pied	Forest, lowland	Large	Asia, India
Tickell's Brown	Forest, lowland/foothill	Medium	Asia, mainland
White-throated Brown	Forest, lowland/foothill	Medium	Asia, mainland
Great	Forest, lowland/hill	Very Large	Asia, main-/Sundaland
Black	Forest, lowland	Medium	Asia, Sundaland
Helmeted	Forest, lowland/foothill	Very large	Asia, Sundaland
Wrinkled*	Forest, lowland	Large	Asia, Sundaland
Rhinoceros	Forest, lowland/foothill	Very large	Asia, Sundaland
White-crowned	Forest, lowland/foothill	Large	Asia, Sundaland
Of Least Concern (bulk of population stable)			
Luzon Tarictic	Forest, large island	Small	Asia, Philippines
Samar Tarictic	Forest, small islands	Small	Asia, Philippines
Mindanao Tarictic	Forest, large island	Small	Asia, Philippines
Malabar Grey	Forest, lowland	Small	Asia, West India
Indian Grey	Forest, deciduous	Small	Asia, India
Sri Lanka Grey	Forest, lowland/foothill	Small	Asia, Sri Lanka
Oriental Pied	Forest, margins	Medium	Asia, main-/Sundaland
Wreathed	Forest, lowland-hill	Very large	Asia, main-/Sundaland
Bushy-crested	Forest, lowland/foothill	Large	Asia, Sundaland
Papuan	Forest, islands	Large	Australasia
Abyssinian Ground	Savanna	Very large	Africa, West/North-east
Black-and-white-casqued	Forest, lowland/patchy	Medium	Africa, West/Central
Black-casqued	Forest, lowland	Large	Africa, West/Central
White-thighed	Forest, lowland	Medium	Africa, West/Central
Piping	Forest, lowland	Small	Africa, West/Central
White-crested	Forest, lowland	Small	Africa, West/Central
Black Dwarf	Forest, lowland	Very small	Africa, West/Central
Red-billed Dwarf	Forest, lowland	Very small	Africa, West/Central
African Pied**	Forest, lowland	Small	Africa, West/Central
Silvery-cheeked	Forest, patchy	Medium	Africa, East/Central/South
Trumpeter	Forest, patchy	Medium	Africa, East/Central/South
Crowned	Forest, patchy	Small	Africa, East/Central/South
Hemprich's	Savanna, arid	Small	Africa, North-east
Jackson's*	Savanna, arid	Small	Africa, North-east
Eastern Yellow-billed	Savanna, open	Small	Africa, East
Von der Decken's	Savanna, open	Small	Africa, East
Pale-billed**	Savanna, miombo	Small	Africa, Central
Southern Yellow-billed	Savanna, open	Small	Africa, Central/South
Bradfield's	Savanna, teak	Small	Africa, South-west
Monteiro's	Savanna, arid	Small	Africa, South-west
Red-billed**	Savanna, open	Small	Africa, West/East/South
African Grey	Savanna, open	Small	Africa, West/East/South

GLOSSARY

Terms and abbreviations used

Allopecies: Two related species replacing each other geographically.

Altricial: Birds with young that initially require total care by the parents before they are able to survive on their own.

Clinal: Gradual genetic and/or morphological differences over a geographical area.

Congeners: Species within the same genus.

Conspecific: Of the same species.

DBH: A tree's Diameter at Breast Height (1.37 m, 4.5 ft).

Endemic: Unique to a defined geographic location, such as an island or nation.

Fledging period: Time in days from when an egg hatches to when the resulting chick leaves the nest.

Frugivorous: Feeding on fruits.

Immature: A young bird not yet sexually mature.

Incubation period: Time in days from when an egg is laid until it hatches.

Insectivorous: Feeding on insects.

Juvenile: A young bird in its first complete plumage after fledging from the nest.

Ma: Millions of years ago.

m a.s.l.: Meters above sea level.

Miombo: Swahili for woodlands dominated by trees of the genus *Brachystegia*.

Monotypic: The sole representative form in its species, genus or family.

Montane: Pertaining to areas above 900 meters in elevation.

Nestling period: For hornbills, used synonymously with fledging period.

Nomadic: Moves around erratically outside principal home range when not breeding.

Nominate race: The first-named race of a species with the sub-specific scientific name the same as the specific name.

NP: National Park.

Oriental region: A faunal region including South and South-east Asia (some sources use the term Indomalaya Ecozone or other variants of this).

Primary forest: Original, virgin forest.

Race: Distinctive geographical form of a species (used synonymously with subspecies).

Secondary forest: Logged or otherwise disturbed and re-growing forest.

Subspecies: A population visibly (sometimes only in the hand) or aurally distinguishable from other populations of the same species.

Sunda/Sundaland: A faunal subregion covering the Malay Peninsula (including southern Thailand), Borneo, Sumatra, Java and Bali, and associated smaller islands like Singapore.

Superciliary: Relating to the area of the eye-brow.

Superspecies: A group of closely related allopecies.

Sympatric: Where two or more species occur in the same area over some or all of their distribution.

Wattle: A patch of coloured skin hanging from the head or neck.

WS: Wildlife Sanctuary.

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Useful websites

About the Hornbill Research Foundation and the Thailand Hornbill Project:
www.sc.mahidol.ac.th/research/hornbill.htm
[www.facebook.com/page/THAILAND HORNBILL PROJECT](https://www.facebook.com/page/THAILAND-HORNBILL-PROJECT)

For updates on individual hornbill species status:
<http://www.birdlife.org/datazone/home>

About hornbill conservation projects:
www.mabulagroundhornbillconservationproject.org.za/
www.coraciiformestag.com/Conservation/Conservation.htm

Pilai Poonswad



Professor Pilai Poonswad was born in 1946. She obtained a B.Ed. and Graduate Diploma in Nuclear Technology at Chulalongkorn University, M.Sc. in Microbiology at Mahidol University and D.Sc. in Biology at Osaka City University, Japan. She is currently Emeritus Professor in Biology at the Department of Microbiology, Faculty of Science, Mahidol University. She is the representative of Thailand at the International Ornithological Union, a

founder and committee member of the Hornbill Research Foundation and elected as a Honorary Fellow of American Ornithologist Union.

Prof. Poonswad began to study hornbills in Khao Yai National Park in 1978 and set up the Thailand Hornbill Project to study the biology and ecology of hornbills in 1979. She became a Laureate of The Rolex Awards for Enterprise in 2006, presented by Rolex SA, Switzerland, for efforts to protect hornbills and their habitats. She has also won the 52nd Annual Chevron Conservation Award 2006 presented by the Chevron Corporation, USA. In Thailand, she received the Dushdi Mala Medal for Great Eminence in Science from His Majesty King Bhumibhol (King Rama IX) (2007), the highest national award; National Outstanding Person Award (in Natural Resources and Environment Conservation) (2007) by the Prime Minister's Office, Royal Thai Government; Outstanding Lecturer Award (in Science and Technology) by the Council of the University Faculty Senates of Thailand (2006) and Mahidol University Prize for Excellence in Research (2005).

Her research findings have been continuously published and disseminated in various forms of media both national and international, including peer-reviewed journals, newspapers, magazines, books, TV programs, radio and documentary films.

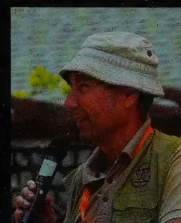
Alan Kemp



Alan Kemp was born in 1944 and brought up in Zimbabwe, where his volunteer work for the National Museums exposed him to various aspects of wonderful natural habitats and wildlife. After graduating in Zoology and Entomology from Rhodes University in South Africa in 1966, Alan worked for three years in the Kruger National Park as a research assistant for Syracuse and then Cornell Universities, mainly on raptors but also with

time to collect data for his doctorate on small savanna hornbills. He completed his thesis at the then Transvaal Museum in South Africa and was appointed to the bird research department where he extended his hornbill work to Monteiro's Hornbill and Southern Ground-hornbill. During his 30 years at the museum he was later able to visit Botswana, Zimbabwe, Mozambique, Zambia, Malawi, Ivory Coast, Kenya, India, Indonesia, Malaysia, Thailand and Australia in pursuit of hornbills and raptors. This culminated in a 1995 monograph on the Bucerotiformes for Oxford University Press. Alan always worked closely with his wife Meg, and in retirement they both still assist with hornbill studies.

Morten Strange



Morten Strange was born in Denmark in 1952. A short petroleum engineering career brought him to Singapore in 1980; after retirement from the oil business in 1986, he set up his own business, providing nature photography and writing, especially about tropical rainforest birds. He worked with Dr. Poonswad in the 1990s and followed her research teams to the field to record her work on the hornbills in photographs and text. Since 1993, Morten

has written and illustrated five photographic guides to the birds of Malaysia, Indonesia and South-east Asia. He has now moved from active photography into editing and publishing; currently he owns his own publishing company, Draco Publishing & Distribution Pte Ltd.

A PHOTOGRAPHIC GUIDE

HORNBILLS OF THE WORLD

HORNBILLS (order: Bucerotiformes) are a group of distinctive and charismatic birds found only in Tropical Asia and Sub-Saharan Africa. There are two families (Bucorvidae and Bucerotidae), 15 genera, 57 species and 75 subspecies; 32 species are in Asia and 25 species in Africa. They are mostly large in size and have long bills surmounted in many species by a conspicuous casque. Hornbills are omnivorous, but each species feeds predominately on fruits or small animals. Many hornbills are important seed dispersers and benefit the forest ecology. During the breeding season, the female enters a nesting cavity, usually in a large hardwood tree. She seals herself inside the cavity in the majority of species and stays there for much of the nesting cycle while the male brings food to her and her young. Most hornbill species are forest birds, dependant on large expanses of primary tropical rainforest for habitat, while some inhabit drier savanna, but all are vulnerable to disturbance and habitat loss.

This is the first authoritative photographic guide to the order. All species are described and illustrated in multiple photographs showing both male and female, and distinct subspecies. There is additional information on:

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- Breeding Ecology
- Social Life
- Threats and Conservation

Dr. Pilai Poonswad (Thailand), **Dr. Alan Kemp** (South Africa), and **Morten Strange** (Singapore) are all renowned hornbill experts and/or bird-book writers. **Dr. Tim Laman** (USA) and 61 other world class photographers have made their best work available. The book was produced in co-operation with the Hornbill Research Foundation in Thailand, and proceeds will be donated to hornbill research and conservation.



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